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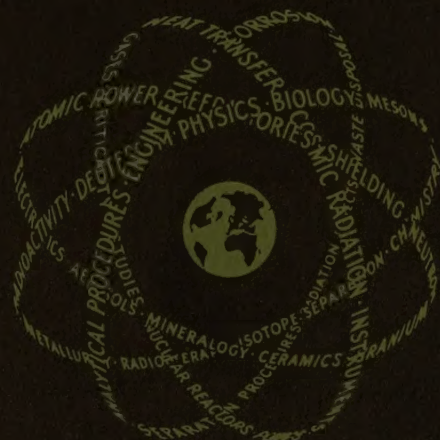
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11 Feb. 60

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NUCLEAR SCIENCE ABSTRACTS



Volume 13 Number 11 June 15, 1959

GENERAL

9512 SCTM-78-59(51)

Sandia Corp., Albuquerque, N. Mex.

EARTH MOVING BY NUCLEAR EXPLOSIVES. M. L. Merritt. Mar. 1959. 14p. Contract [AT(29-1)-789]. \$3.30(ph), \$2.40(mf) OTS.

Presented Mar. 6, 1959 to a meeting of the Rocky Mountain Section of the American Society for Test-Materials, at Salt Lake City.

Nuclear explosives promise to open new fields in peacetime earthmoving projects in spite of their undesirable side effects. Residual fall-out and long-range blast problems can be controlled by careful choice of meteorology at time of burst. Nuclear explosives have energy concentrations and rates of energy release many times those of chemical explosives which suggest exploiting their craters for excavation. Studies have been made of the feasibility and costs of using NE for excavating harbors, digging canals, breaking rock for fill material, and excavating sedimentation basins. (auth)

9513 UCRL-5457

California, Univ., Livermore. Lawrence Radiation Lab.

LARGE SCALE EXCAVATION WITH NUCLEAR EXPLOSIVES. Clifford M. Bacigalupi. Jan. 1959. 17p. Contract W-7405-eng-48. \$0.50(OTS).

An approach which can be used for making basic preliminary calculations of excavations by nuclear explosives is presented. (W.L.H.)

9514

NUCLEAR ENERGY IN THE NETHERLANDS. Atomic World 10, 68-72(1959) Feb.

The Netherlands achievements in the fields of nuclear ship propulsion, power and research reactors, and isotope separation are discussed. The reactors under construction or proposed in Holland are listed. (J.H.M.)

9515

THE APPEARANCE OF RELATIVELY HIGHLY RADIOACTIVE PARTICLES OF LONG HALF LIFE IN ATMOSPHERIC AEROSOLS. J. A. Scheduling and W. A. Müller (Univ. of Vienna). Atomkernenergie 4, 72-4(1959) Feb. (In German)

Samples of atmospheric aerosols were collected on filter paper and fiber filters, and the β activity of these samples was determined. Striking differences in the activities of aerosol samples collected under the same conditions suggested that the long lived activity is unequally distributed on the support aerosols. Autoradiograph confirmed this conjecture. By means of the

autoradiographic picture little filter areas each carrying one particle of particularly strong activity were separated. The separate determination of the β activity of these little areas (0.5% of the total filter-area) showed that sometimes (judging on the measurements up to middle of July 1958) more than 50% of the total activity of the filter can be attributed to such a little filter element. (auth)

9516

TIGHTNESS AND TIGHTNESS TESTING IN NUCLEAR TECHNOLOGY. Z. Thiel (Gutehoffnungshütte, Sterkrade AG., Werk Sterkrade, Oberhausen, Ger.). Atomkernenergie 4, 75-80(1959) Feb. (In German)

The development in the field of nuclear engineering makes it necessary to apply most exacting standards to the tightness problem in large plants. The conventional testing methods cannot meet this requirement. The importance of the tightness problem is shown by some examples of existing plants. Various methods of tightness testing and leak detection are discussed. The advantages and disadvantages of such methods are outlined and special reference is made to the possibilities and limits of application for the various testing procedures. A few words are said about the expense of time and money for the various methods. Finally a general leak detection program is indicated. (auth)

9517

NATURAL RADIOACTIVITY OF RAINFALL. L. D. Solodikhina (Inst. of Applied Geophysics, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R. Ser. Geofiz. No. 2, 276-83(1959) Feb. (In Russian)

It was found that the magnitude of specific activity in precipitations falls with an increase in precipitation. The concentration of observed radioactivity is expressed in the following order: granular snow, showers, snow flakes, and steady rain. Analysis of 46 samples at 3150 and 2200 m elevation shows that rains wash out radioactive substances in the lower layers of the atmosphere. (R.V.J.)

9518

ATOMS FOR PEACE—ON TRIAL. Ashton J. O'Donnell (Stanford Research Inst., Calif.). J. Stanford Research Inst. 3, 10-24(1959).

The international Atoms for Peace program is reviewed as to its progress in each of the objectives initially stated. (T.R.H.)

9519

NUCLEAR EXPLOSIONS IN SPACE. [Part I]. S. Fred Singer (Univ. of Maryland, College Park). Missiles and Rockets 5, No. 13, 33-6(1959) Mar. 30.

Charged particle behavior in a magnetic field is discussed, and theories pertaining to the earth's natural radiation belts are outlined. The production of an artificial radiation belt by an orbiting electron accelerator for scientific purposes is described. (T.R.H.)

9520

NUCLEAR EXPLOSIONS IN SPACE. [Part 2]. S. Fred Singer (Univ. of Maryland, College Park). Missiles and Rockets 5, No. 14, 36-8; 40(1959) Apr. 6.

Information is given on the effects of the radiation belts and of nuclear explosions in space on space travellers, rockets, and nuclear warheads. (T.R.H.)

9521

DETERMINATION OF THE AEROSOL DURATION FROM THE RaD AND RaF CONTENT OF THE ATMOSPHERIC AIR AND FALLOUT. L. Lehmann and A. Sittkus (Univ. of Freiburg i. B.). Naturwissenschaften 46, 9-10(1959). (In German)

The deviation of the concentrations of radon decay products from equilibrium permits an estimation of the life of aerosols in the atmosphere. In the months of April to August 1957, air and rain water samples were collected, and the contents of RaD and RaF were determined. The measurements from the air samples gave a value of 1.5 days from the RaC/RaD ratio and 14 days from the RaF/RaD ratio. The measurement of the rain samples gave 33 days from the RaF/RaD ratio. The values of RaC and RaD concentrations are in good agreement with the values obtained by others. (J.S.R.)

9522

GAS-LUBRICATED BEARINGS IN NUCLEAR ENGINEERING. PART II. D. Pantall and C. H. Robinson. Nuclear Eng. 4, 123-8(1959) Mar.

Hydrostatic (pressurized) types of gas-lubricated bearings are considered. The important features of plain journals are analyzed, and thrust bearings are discussed. (W.D.M.)

9523

PRODUCTION AND MEASUREMENT OF ULTRA-HIGH VACUA. J. Dutton (University Coll. of Swansea, Wales). Research (London) 12, 103-6(1959) Mar.

Recent experiments which have lead to the development of ultra-high vacuum systems, in which residual gas pressures as low as 10^{-10} mm Hg are obtained and measured by means of a combined ionization pump and gage, are described. Some of the applications of such systems are briefly outlined. (auth)

9524

THE IMPACT OF THE ATOM ON PRESENT SOURCES OF ENERGY. Robert E. Wilson. Ricerca sci. 29, 3-13(1959) Jan.

The probable consequences of nuclear energy, if its applications are developed on the basis of a free economy, are considered. It is stated that in the beginning the number of thermonuclear power plants organized on such commercial principles will be rather small. The possible consequences of nuclear energy to the coal and oil industries and the presently very remote possibility of the use of fusion energy are analyzed. It is concluded that any pessimism on the future of nuclear energy, either by fission or by fusion, as well as on other future sources of energy, is groundless. (auth)

9525

INCREASE OF C^{14} IN THE ATMOSPHERE FROM ARTIFICIAL SOURCES MEASURED IN A CALIFORNIA TREE. George S. Bien and H. E. Suess (Scripps

Institution of Oceanography, La Jolla). Z. Physik 154, 172-4(1959).

The increase in the C^{14} content of the atmosphere was determined by a measurement of the increased activity in a Ponderosa Pine in California. To avoid effects from diffusion of organic material within the tree, the lignite was separated from the rest of the wood components. The results, after correction for differences in C^{13} concentration, showed a $10.49 \pm 0.2\%$ increase since 1953. (J.S.R.)

9526

SPACE HANDBOOK: ASTRONAUTICS AND ITS APPLICATIONS. STAFF REPORT OF THE SELECT COMMITTEE ON ASTRONAUTICS AND SPACE EXPLORATION. Washington, Select Committee on Astronautics and Space Exploration, 1959. 256p. Available from Government Printing Office, Washington for \$0.60.

A review is given of the general nature of astronautics, current state of space technology, and considerations for the future in space exploration. More detailed information is presented on the following: space environment; trajectories and orbits; rocket vehicles; propulsion systems; propellants; internal power sources; structures and materials; flight path and orientation; guidance; communication; observation and tracking; atmospheric flight; landing and recovery; environment of manned systems; space stations and extraterrestrial bases; nuclear weapon effects in space; cost factors and ground facilities; and current programs. Specific flight possibilities are discussed, plus information on observation, meteorological, navigation, and balloon satellites. Considerations are given to the possibility of relaying signals and bombing from satellites and scientific space exploration. Included also is information on astronautics in the U.S.S.R., the United Kingdom, and the People's Republic of China. (J.H.M.)

9527

RADIOISOTOPES IN THE SERVICE OF MAN.

Fernand Lot. Paris, United Nations Educational, Scientific and Cultural Organization, 1958. 84p. \$1.00. U. S. Distributor: International Publications, Inc., New York.

What radioisotopes are, their history of development, how they are produced, and how they are detected and measured are discussed as preliminary to description of their use in research, therapy, industry, and agriculture. (T.R.H.)

9528

ZASHCHITA OT SREDSTV MASSOVOGO PORAZHENiya. (Defense Against Weapons of Mass Destruction.) M. Ye. Levin, G. A. Malinin, M. N. Mandrazhitskii, V. P. Sinitsyn, and V. I. Fedorov. Moscow, Uchpedgiz, 1958. 181p.

General information on atomic, chemical, and bacteriological weapons and individual and collective defense measures against them are reported. The topics discussed include the following: modern means of air attack; atomic weapons and their destructive force; impact, fragmentation, and incendiary means of destruction; chemical weapons and their destructive effect; bacteriological weapons and their destructive effect; individual means of protection; collective means of protection; protection of food products, water, and forage from contamination by poison gases, radioactive substances, and bacterial agents; problems and organization of local antiaircraft defense for dwellings, enter-

prises, institutions, state farms, and collective farms; surveying destruction centers; emergency rescue work in a destruction center; fire preventive measures and the extinguishing of flare-ups and fires; means and methods of deactivation, degasification, and disinfection; and duties of civil defense personnel on the sounding of local anti-aircraft defense signals. (TCO-J.S.R.)

9529

5^a RASSEGNA INTERNAZIONALE ELETTRONICA E NUCLEARE. ATTI DEL CONGRESSO SCIENTIFICO, GIUGNO 16-20, 1958. VOLUME I. SEZIONE NUCLEARE. (5th International Electronic and Nuclear Review. Acta of the Scientific Congress, June 16-20, 1958. Volume I. Nuclear Section.) Rome, Comitato Nazionale delle Ricerche Nucleari, [1958]. 738p. 5,000 Lira.

The papers given at the 5th International Electronic and Nuclear Review, June 16 to June 20, 1958, in Rome are presented. Separate abstracts of the papers were prepared. (J.S.R.)

9530

SOME TRENDS OF APPLIED RESEARCH IN THE FIELD OF NUCLEAR ENERGY. Sergio Gallone. p. 53-65 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In Italian)

A brief survey is given of the guiding ideas in nuclear energy research in industrial organizations. The orientation of the research program at AGIP Nucleare is discussed, and the laboratory is described. (J.S.R.)

9531

A SIMULATOR FOR REACTOR KINETICS. Vincenzo Gervasio and Pasquale Casale. p. 67-75 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In Italian)

The simulator for reactor kinetics used in the electronic laboratory of the AGIP Nucleare is described. The schemes used for the resolution of various problems are discussed. (J.S.R.)

9532

PRELIMINARY PROGRESS OF A NUCLEAR PROPULSION PLANT FOR A TURBO-TANKER OF 70,000-TON DISPLACEMENT UNDER FULL LOAD. G. Previti and A. Ridolfo. p. 77-131 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In Italian)

The initial design studies on a pressurized water reactor for propulsion of a tanker are presented. A general description of the ship is given and compared with the characteristics of a conventionally propelled ship. The engineering, the instrumentation, the control, and an analysis of the dangers are discussed in detail. More advanced studies on the construction of some parts of the propulsion system, the fuel recovery, and handling of liquid wastes are also presented. (J.S.R.)

9533

INTRINSIC AND ENVIRONMENTAL ASPECTS OF THE SAFETY OF A NUCLEAR POWER PLANT. Marcello Pagliari. p. 147-63 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In Italian)

In the planning of a nuclear power plant, not only must technical and economic aspects be considered, but the possible dangers to the plant personnel and to the inhabitants of the surrounding region must also be

investigated. The factors in the protection of the personnel against external and internal exposure to radioactivity are discussed. Then the hydrological and meteorological factors which determine the safety of the inhabitants in the vicinity are reviewed. The possibility of an accident and the gravest results of an accident must also be considered. (J.S.R.)

9534

LIFE SPANS OF SOME FUELS WITH URANIUM METAL BASE. M. J. A. Stohr and M. Englander (Commissariat à l'Énergie Atomique, Paris). p. 215-31 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In French)

The factors governing the life span of natural uranium fuels used in gas cooled heterogeneous reactors with a specific power of the order of 25 to 50 w/cm² are discussed. It appears that the life span can be considerably prolonged at the expense of a low loss in reactivity by the introduction of a very small percentage of an element which gives, under predetermined casting conditions, a fine lamellar eutectoid decomposition. Such a fuel element appears stable under irradiation, or at least its cyclic evolution does not seem to cause perturbations to the geometry and stability. The results obtained with small additions of Al or Mo are discussed. (J.S.R.)

9535

THE REMOVAL OF RADIOSTRONTIUM FROM WATER. Edmondo Zamorani and A. Pizzolo. p. 233-47 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In Italian)

The factors affecting the removal of radiostrontium from water solutions with sodium phosphate and calcium hydroxide were investigated. The factors studied were acidity of the medium, value of the ratio $\text{Na}_3\text{PO}_4/\text{Ca}(\text{OH})_2$, contact time for the liquid and solid phase, and effect of the molarity of the Sr carrier. The results are graphed and show that the phosphate-calcium method, under some conditions, removes 99% of the strontium activity. Preliminary results from a magnesium phosphate precipitation are given. (J.S.R.)

9536

APPLICATION OF QUANTITATIVE STUDY OF PLEOCHROIC HALOS TO THE AGE ESTIMATION OF ROCKS. Sarah Deutsch (Univ. of Brussels). p. 307-14 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In French)

To develop a method of dating rocks based on the phenomenon of pleochroic halos, the quantitative relationships existing between the coloration of granite biotites and the total dose of alpha particles received by the mineral were studied. Granites of known age with halos around large inclusions and artificial coloration of cleavage planes experimental irradiation were investigated by the photographic plate technique. The laws of natural and artificial coloration of the biotite were determined, and the quantitative measurements were applied to the age estimation of rocks. The range of application of the method is discussed, especially to very young rocks. Examples of the age determination are given. (J.S.R.)

9537

MEASUREMENT OF THE AGE OF SOME TERTIARY GRANITES OF TUSCANY BY THE PLEOCHROIC HALO

METHOD. Sarah Deutsch (Univ. of Brussels) and Antonio Longinello (Laboratorio di geologia nucleare, Pisa, Italy). p. 315-18 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In Italian)

The pleochroic halo method was used for the age estimation of granites from the islands of Monte Cristo and Giglio and from Gavorrano. The results showed that the granite of Monte Cristo is approximately the same age as the granites of Elba, but that those of Giglio and Gavorrano are younger by a factor of 1.5 and 3, respectively. (J.S.R.)

9538

DETERMINATION OF THE ABSOLUTE AGE OF SOME URANIUM AND THORIUM ORES. D. Ledent (Univ. of Brussels). p. 319-25 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In French)

The advantages and disadvantages of the RaD and ThB methods for the absolute age determination of uranium and thorium ores are described, and the methods are compared with the more common lead method. (J.S.R.)

9539

INITIAL ITALIAN RESULTS ON THE EFFECTS OF IONIZING RADIATIONS ON AGRICULTURAL PLANTS. F. D'Amato, S. Avanzi, E. Moschini, and G. T. Scarascia. p. 329-54 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In Italian)

The effects of ionizing radiation were investigated in wheat, tobacco, and flax. Seeds of durum and soft wheat were exposed to varying doses of x radiation and thermal neutrons. Detailed studies of the R_1 effects were made to correlate them with the R_2 and succeeding generations. Thermal neutrons appeared to have a greater sterility effect than x rays, and the durum wheat was more radiosensitive. Dormant seeds of four varieties of tobacco were irradiated with three different doses of thermal neutrons, the highest of which (10.8×10^{13} n/cm²) appeared to be lethal. The R_1 effects were studied with respect to the R_2 effects. Virginia Bright appeared to be the most radiosensitive. Bison flax was exposed to chronic or acute gamma irradiation. Acute irradiation (1,000 to 10,000 r at tetrad and pollen grain stages) resulted principally in a sterilizing effect at the highest doses. Chronic irradiation (190 to 425 r daily from sowing to harvest) caused earlier flowering at doses of 190 and 260 r and stem and flower fasciation reaching a maximum at 425 r. The R_2 effects were studied. (J.S.R.)

9540

PLANT BREEDING AND MUTATIONS. Ake Gustafsson (Forest Research Inst., Stockholm). p. 355-91 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In German)

A survey is presented of the work and principal results obtained in the investigation of mutations in plants. The induction of mutations by various radiations, effect of mutations on population structure, mutation types with respect to vitality and yield, and rigidity in barley and wheat are considered. 69 references. (J.S.R.)

9541

APPLICATIONS OF RADIOACTIVE ISOTOPES AS TRACERS IN VEGETABLE PATHOLOGY. Elio

Baldacci and E. Betto (Univ. of Milan). p. 393-406 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In Italian)

Typical examples of the application of radioisotopes as tracers in vegetable pathology are presented. For vascular malfunctions, the research on the diffusion of elements and the metabolism of toxic materials in diseased plants in relationship to the development of symptoms is reported. The use of P³² in the investigation of necrotic and trophic diseases is also discussed. (J.S.R.)

9542

CONSERVATION OF AGRICULTURAL AND FOOD PRODUCTS BY IRRADIATION. AN EXAMPLE, POTATOES. Pierre Vidal. p. 407-43 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In French)

The results of investigations on the preservation of potatoes by gamma radiation are reported. It appears that the irradiation of potatoes with gamma doses of 10,000 rads does not hasten the blackening of cut and peeled potatoes up to five hours. The 10,000 rad dose causes no dangerous modification, and the mechanical resistance of the epidermis is not affected. Irradiation with 10,000 rads of gamma radiation, independently of the inhibitory action on germination, preserves an aspect as fresh as that of newly harvested potatoes. (J.S.R.)

9543

THE USE OF RADIOISOTOPES FOR DETERMINING THE PARTICULARITIES OF PLASTIC EXCHANGE OF THE BRAIN. Cheorghii E. Vladimirov (Academy of Medical Sciences, Moscow). p. 445-60 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In French)

By the use of radioisotopes, the dimensions of the renewal of the major part of the chemical constituents of the brain were determined. This method also permits a definition of the free energy of hydrolysis of ATP by determining the equilibrium constant of the hexokinase and phosphatase reactions. The data obtained gave an approximation of the extent of the total energy necessary for synthetic processes in the brain. The major part of the energy is consumed to assure the functional activities of the nervous tissue. (tr-auth)

9544

FULLY AUTOMATIC MECHANIZED IRRADIATION INSTALLATIONS WITH MULTIKILOCURIE Co⁶⁰ SOURCES FOR SCIENTIFIC RESEARCH. Otto F. Joklik (Transcontinental Atomic Co. Establishment, Vaduz, Liechtenstein). p. 487-547 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In German)

A detailed description is given of the design and construction of a gamma irradiator with a 5,000 c Co⁶⁰ source. The irradiation techniques used are briefly discussed. (J.S.R.)

9545

INDUCTION OF POLYGENIC MUTATIONS WITH X RAYS. Renzo Scossioli (Univ. of Pavia, Italy). p. 549-65 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In Italian)

Experiments were made on *Drosophila* to obtain in-

formation on the mutability of polygenic characteristics under irradiation conditions and on the relative importance of the increase of mutation frequency and recombination in a selection experiment. The results showed that x radiation itself has great effectiveness in the induction of new genetic variability through polygenic mutants. Artificial selection utilizes to a large degree the new genetic variability. In selection experiments with non-homogeneous populations, at the end of the selection processes, there is an increase of recombinations which contribute to the increase of the selection with liberation of persistent and fixed genetic variability in polygenic blocks. (J.S.R.)

9546

RADIATION INDUCED AND NATURAL CHROMOSOME DISLOCATIONS IN *DROSOPHILA SUBOBSCURA*. Felix Mainx (Univ. of Vienna). p. 567-73 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In German)

A preliminary report on investigations of radiation-induced and natural chromosome dislocations in *Drosophila subobscura* is presented. A localization of 152 breaks of the natural inversions shows that the distribution of the broken places over the chromosomes is not a probability distribution. The inversions and translocations caused by x radiation show the same distribution. (J.S.R.)

9547

TECHNICAL AND STATISTICAL ASPECTS OF THE PROBLEMS ARISING FROM THE INSURING OF ATOMIC RISKS. Brune de Mori (Unione Italiana di Riassicurazione, Rome). p. 577-91 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In Italian)

The essential problem in the insuring against atomic risks is a proper evaluation of the dangers inherent in the reactor itself. The criteria which can be used for the assessment of these dangers are discussed. The civil responsibility toward the third party is also considered. The insuring of maritime and aeronautical reactors necessitates the consideration of not only the usual risks but the added dangers of nuclear energy. This aspect is briefly discussed as a problem which must be solved. (J.S.R.)

9548

PROBLEMS ARISING OUT OF THE EVALUATION OF HAZARDS FOR THE INSURANCE OF NUCLEAR REACTORS. A. G. M. Batten (British Insurance (Atomic Energy) Committee, London) and J. L. Gillams (United Kingdom Atomic Energy Authority, London). p. 593-605 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section."

An outline is presented of the technical factors which are considered in Great Britain in the insuring of reactors. The types of insurance risk, possible sources of hazard, and factors involved in the assessment of hazards are considered. (J.S.R.)

9549

ATOMIC INSURANCE AND LEGISLATION. H. Maury. p. 621-30 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In French)

Along with the insurance of atomic risks, there should be adequate legislation. The necessity of uniform and international legislation on the construction and operation of reactors is shown. (J.S.R.)

9550

THIRD-PARTY RESPONSIBILITY TO THE USER OF NUCLEAR PLANTS. Giuseppe Belli. p. 607-19 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In Italian)

The problem of third party responsibility is a complex one, and one which must be solved by the legislatures of the various countries. The work of the Economic Organization of the European Community with respect to third-party liability is discussed on the basis of the nature of the responsibility, the responsibility of the state, the subject of the responsibility, limitations of the responsibility, duration of the responsibility, and the federal responsibility for the incidents. (J.S.R.)

BIOLOGY AND MEDICINE

9551

AECU-3988

Long Island Biological Assn. Biological Lab., Cold Spring Harbor, N. Y.

FINAL PROGRESS REPORT FOR DECEMBER 16, 1957-AUGUST 31, 1958. Bruce Wallace. 12p. Contract AT(30-1)-557. (LIBA-10). \$3.30(ph), \$2.40(mf) OTS.

Implications of the findings are summarized from a 9-year study on the adaptive values of experimental populations of *Drosophila melanogaster*. Emphasis was placed on genetic changes and adaptive values in populations under irradiation. The relative fitness of irradiated and non-irradiated populations was also investigated. Two alternative models for the genetic structure of Mendelian populations are considered. Contradictions between expected and observed results led to the proposal of the alternative model for the genetic structure of *Drosophila* populations. An attempt was made to evaluate the role of heterosis in the day-to-day existence of populations. It was concluded that mutation is a necessary evil tolerated by organisms in order to meet environmental fluctuations measured on a geological time scale. A model based on the selective superiority of heterozygous individuals requires mutations as a continuing source of genetic variability. Mutation is the only source of new alleles, and all other factors at work within a Mendelian population lead toward uniformity. Consequently, any genetic system which relies on genetic diversity must rely on mutation as well. The relation of genetic structure to problems of radiation damage is considered. The proposed model would lead to a reduction in the amount of genetic damage, not to an elimination of the damage. A list is included of 23 papers prepared during the time of this contract. (C.H.)

9552

AERE-C/R-1399

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE ANALYSIS OF URINE FOR TRACES OF AMERICIUM AND OTHER ALPHA EMITTERS. E. N. Jenkins and G. W. Sneddon. Nov. 10, 1954. 23p.

A method in use at the Argonne National Laboratory for the estimation of actinium, thorium, neptunium, plutonium, americium, and curium in urine involves the coprecipitation of these alpha emitters on bismuth phosphate from a nitric acid solution of oxidized urine, followed by the re-solution of the precipitate in hydro-

chloric acid and a second coprecipitation with a restricted quantity of lanthanum fluoride carrier, which is subsequently alpha counted. The present work was concerned with the recovery of americium from urine, and revealed serious potential interferences from reagent blanks, from acidity, from chloride and from iron. The method was successfully modified to eliminate such interferences, when recoveries of the order of 90 were obtained from twenty-four hour urine samples at a level of 3 disintegrations minute⁻¹ of added americium. (auth)

9553 HW-58334

General Electric Co. Hanford Atomic Products
Operation, Richland, Wash.

CHEMICAL TOXICITY OF PLUTONIUM IN YEAST.
W. J. Bair and F. P. Hungate. Dec. 3, 1958. 14p.
Contract W-31-109-Eng-52. \$0.50(OTS).

Tentative evidence for chemical toxicity effects of Pu²³⁹ on yeast is presented. Inhibition of glucose uptake and respiration in *Saccharomyces cerevisiae* exposed to Pu²³⁹ was greater than predicted from the radiation dose. Also, in growth studies the inhibition observed was much greater than expected from radiation effects alone. (auth)

9554 NM-62-02-00.01.03

National Inst. of Arthritis and Metabolic Diseases,
Bethesda, Md.; National Institutes of Health. Clinical
Center, Bethesda, Md.; National Cancer Inst.,
Bethesda, Md.; and Naval Medical Research Inst.,
Bethesda, Md.

THE HEMOLYTIC EFFECT OF IONIZING RADIATIONS
AND ITS RELATIONSHIP TO THE HEMORRHAGIC
PHASE OF RADIATION INJURY. Frederick Stohman,
Jr., George Brecher, Marvin Schneiderman, and Eugene
P. Cronkite. Mar. 21, 1958. 27p.

The hemolytic effects of ionizing radiation in the dog were investigated using the Cr⁵¹ technique. When cells were collected from irradiated dogs and transfused into compatible normal recipients, it was not possible to demonstrate red cell damage prior to the 10th post-irradiation day. Studies of cells collected between the 5th and 10th post-irradiation day were equivocal, and survival of cells collected on the 3rd day was normal. In contrast, when tagged cells were allowed to circulate in the irradiated animal, damage to the red cell could be demonstrated as early as the 1st to 3rd post-irradiation day. In these studies tagged cells were transfused 5 to 55 days prior to irradiation in order to establish the elution rate of Cr⁵¹. On the 1st to 3rd day following irradiation there was an abrupt increase in the rate of Cr⁵¹ loss. When normal cells were transfused immediately after irradiation there was also a striking increase in the rate of Cr⁵¹ loss above that observed in normal animals, indicating that radiation damage to the red cell was indirect. Since damage to the red cell was apparent much sooner when chromium was present in the cells during their exposure to the indirect effects of radiation, it is suggested that the chromium metal produced an additive damage. It was also determined that extravasation and recirculation of red cells during the thrombocytopenic phase of radiation injury led to added damage, whereas normal cells, tagged and injected intramuscularly, survived normally on return to the general circulation. Cells collected from dogs one day after irradiation, tagged with Cr⁵¹ and then injected intramuscularly into normal recipients, showed a striking increase in the rate of destruction.

Cells collected on the 4th post-irradiation day were destroyed even more rapidly. These studies confirmed the early onset of radiation injury to the cells and demonstrated the damage incurred as a result of passage through the extravascular cycle. As might be expected there was also a shortened survival of red cells collected from the thoracic lymph of thrombopenic irradiated animals. It is concluded that ionizing radiations indirectly produce a mild and progressive hemolytic disorder. (auth)

9555 NP-7266

Vanderbilt Univ., Nashville. School of Medicine.
LONG-TERM DOG FEEDING EXPERIMENT ON IRRADIATED CHICKEN, BEEF AND JAM. Progress Report No. 1 [for] February 1, 1957 through March 17, 1958. Frank R. Blood, William J. Darby, Richard C. Dybdahl, Carl E. Miller, Robert J. Dilworth, Donald B. Rogers, and Matthew Wright. 14p. Contract DA-49-007-MD-779.

No effects due to the toxicity of the irradiated foods were noted in dogs maintained for twelve weeks on a diet including 35% solids of irradiated chicken, beef, or jam. (C.H.)

9556 NP-7267

Vanderbilt Univ., Nashville. School of Medicine.
LONG-TERM RAT FEEDING EXPERIMENT ON IRRADIATED BEEF, TWELFTH TO TWENTY-FOURTH WEEK. Progress Report No. 2-C [for] June 3, 1958 to September 3, 1958. Frank R. Blood, William J. Darby, Richard C. Dybdahl, Carl E. Miller, Paul d'Encarnacao, Robert J. Dilworth, John B. Hardin, Donald B. Rogers, and Matthew Wright. 18p. Contract DA-49-007-MD-779.

No effects due to the toxicity of the irradiated food were noted in rats maintained for twenty-four weeks on a diet including 35% of irradiated beef. (C.H.)

9557 NP-7268

Vanderbilt Univ., Nashville. School of Medicine.
LONG-TERM MONKEY FEEDING EXPERIMENT ON IRRADIATED PEACHES, WHOLE ORANGES AND PEELLED ORANGES, TWELFTH TO TWENTY-FOURTH WEEK. Progress Report No. 2B [for] April 14, 1958 to July 12, 1958. Frank R. Blood, William J. Darby, Richard C. Dybdahl, Carl E. Miller, Robert J. Dilworth, Donald B. Rogers, and Matthew Wright. 15p. Contract DA-49-007-MD-779.

Procedures and results are reported from a long-term feeding experiment with monkeys maintained on a diet which included irradiated peaches, whole oranges, or peeled oranges. Hematocrit values, weights, and intraocular pressure values are tabulated following 12 weeks on the three diets. Data are included on irradiation exposure of the food. (C.H.)

9558 NP-7269

Vanderbilt Univ., Nashville. School of Medicine.
LONG-TERM DOG FEEDING EXPERIMENT ON IRRADIATED CHICKEN, BEEF, AND JAM. Progress Report No. 3A [for] June 13, 1958 to September 15, 1958. Frank R. Blood, William J. Darby, Richard C. Dybdahl, Carl E. Miller, Robert J. Dilworth, Paul d'Encarnacao, John B. Hardin, Donald B. Rogers, and Matthew Wright. 13p. Contract DA-49-007-MD-779.

Data are summarized on the physical condition of dogs maintained for 36 weeks on diets containing 35% solids of boned chicken, ground beef, or pineapple jam which has been exposed to radiation of varying doses.

Hematologic examinations revealed normal values for all dogs. Urine analysis revealed glycosuria in the dogs maintained on the diet containing jam. (C.H.)

9559 NP-7270

Vanderbilt Univ., Nashville. School of Medicine. LONG-TERM MONKEY FEEDING EXPERIMENT ON IRRADIATED PEACHES, WHOLE ORANGES AND PEELED ORANGES, TWENTY-FOURTH TO THIRTY-SIXTH WEEK. Progress Report No. 3-B [for] July 12, 1958 to Oct. 12, 1958. Frank R. Blood, William J. Darby, Richard C. Dybdahl, Carl E. Miller, Robert J. Dilworth, Paul d'Encarnacao, John B. Hardin, and Matthew Wright. 17p. Contract DA-49-007-MD-779.

No effects due to the toxicity of the irradiated foods were noted in monkeys maintained for thirty-six weeks on a diet including irradiated peaches, whole oranges, or peeled oranges. (C.H.)

9560 NP-7272

Texas. Agricultural Experiment Station, College Station.

A LONG RANGE INVESTIGATION OF THE NUTRITIONAL PROPERTIES OF IRRADIATED FOOD. Progress Report No. II [for] September 1, 1954 to April 1, 1955. L. R. Richardson. 10p. Contract DA-49-007-MD-582.

Data are presented from preliminary studies on the nutritional properties of irradiated food as demonstrated by reproduction, incidence of blindness, and life span of rats and the growth of chicks. The folic acid content of the liver of chicks was determined by a microbiological procedure. Tests were run to determine the minimum amount of vitamin B₁₂ to support maximum growth of chicks. Studies were initiated on the effects of irradiated diet on rat tissue enzyme activity. (C.H.)

9561 NP-7278

Texas. Agricultural Experiment Station, College Station.

A LONG RANGE INVESTIGATION OF THE NUTRITIONAL PROPERTIES OF IRRADIATED FOOD. Progress Report No. VIII [for] July 1, 1956 to October 1, 1956. L. R. Richardson. 19p. Contract DA-49-007-MD-582.

Data are summarized from a long-range study of the comparative nutritive value of irradiated and untreated diets as demonstrated by observations on rats and chicks. Tabulated data show the effect of an irradiated diet on reproduction, litter size, incidence of blindness, and life span of rats. Studies are reported on the effects of radiation on various combinations of casein and gelatin, biotin, and vitamins in the diet and the response of chicks to an irradiated diet. (C.H.)

9562 NP-7281

Texas. Agricultural Experiment Station, College Station.

A LONG TERM FEEDING STUDY ON CHICKEN AND GREEN BEANS. Progress Report No. II. L. R. Richardson. Oct. 31, 1957. 11p. Contract DA-49-007-MD-582.

Observations on the first generation of rats maintained on a diet of irradiated chicken and green beans indicate that the nutritive value of the irradiated foods is essentially the same as that of nonirradiated diet. (C.H.)

9563 NP-7284

Texas. Agricultural Experimental Station, College Station.

A LONG TERM FEEDING STUDY ON CHICKEN AND GREEN BEANS. Progress Report No. IV [for] March 1, 1958 to September 15, 1958. General Progress Report XII [on] A LONG RANGE INVESTIGATION OF THE NUTRITION PROPERTIES OF IRRADIATED FOOD. L. R. Richardson. 30p. Contract DA-49-007-MD-582.

Data are summarized from a long-term study on the nutritive properties of irradiated foods. Data are presented from observations on rats maintained for three generations on a diet containing irradiated chicken and green beans. Data are tabulated on weight gain, fertility, hematological values, congenital blindness, the nutritive value of irradiated and untreated soybean oil, the nutritive values of irradiated and untreated beef fatty tissues, the composition of a basal diet, and vitamins destroyed by radiation in diets containing 10% of untreated pork fatty tissues. (C.H.)

9564 NP-7301

Chicago. Univ. Air Force Radiation Lab. QUARTERLY PROGRESS REPORT NO. 30. Jan. 15, 1959. 128p. Contract AF41(657)-252.

Preliminary screening studies were conducted on forty fermentation broths in an effort to determine whether such materials might offer sources of radio-protective substances. Both prophylactic and therapeutic effects against radiation injuries were observed with several of the broths, and it was concluded that additional studies with such materials are warranted. Thirty chemical compounds were tested for their protective effects against radiation injuries in mice. Data are tabulated. Ultraviolet spectrophotometric and analytical methods were devised to study the kinetics of the nucleophilic displacement reactions of cyclic imines with thiourea and its analogs. Preliminary rate measurements on the thiourea-ethylenimine reaction and the competitive solvolysis of the aziridinium ion point to the S_N2 mechanism in the ring opening reaction. Synthetic and spectral data are presented to provide evidence for the existence of the charge-separated form of tetramethyl thiourea. Additional synthetic work relating to the kinetic and product identification phases of the study and a radiophrophylaxis program are reported. Results are summarized from studies on the effects of x irradiation on the synthesis of citric acid by rat tissues *in vitro*, the radioprotective effects of certain enzyme inhibitors in animals, measurements of the radioprotective effect of various chemical agents by their ability to modify the radiation-induced changes in the activity of certain enzymes of the intestine, spleen, and thymus gland of rats and mice, and the effects of fractionated low-level doses of gamma and fast neutron irradiation on the life span and reaction time of mice. (For preceding period see NP-7018.) (C.H.)

9565 ORO-188

Oklahoma Medical Research Foundation, Oklahoma City. FINAL REPORT COVERING PERIOD OF MAY 1, 1956 TO JULY 1, 1958. Leonard P. Eliel. 19p. Contract AT(40-1)-1994. \$3.30(ph), \$2.40(mf) OTS.

Results are reported from a study of the isotopes uptake in superficial malignant tumors *in situ* to determine whether such measurements can be used as objective indices of rate of tumor growth in evaluating the results of therapy. The uptake of phosphorus-32, potassium-42, and rubidium-86 was measured following intravenous administration in patients with breast carcinoma, with primary or recurrent lesions on the chest wall, and in patients with leukemia or lymphosarcoma and enlarged superficial nodes. The counting of gamma

emissions from potassium-42 and rubidium-86 was unsatisfactory. Using a beta detector, some concentration of activity was found over superficial tumors during the period immediately after isotope administration. Phosphorus-32 proved more satisfactory for scanning purposes because of its longer half life and because of its concentration in superficial tumor tissue. Results are summarized. It is suggested that phosphorus-32 may be of value in the therapy of bony metastases of breast carcinoma, but not of extra-osseous metastases. The nature of changes in cytochemistry and of isotope uptake induced by chemotherapeutic agents and ionizing radiation in leukemia and lymphosarcomatous tissue in man was investigated. An attempt was made to determine the relationship between changes induced by chemotherapy and clinical response, and to determine whether agents with relatively high tumor specificity induce changes which are characteristic and distinct from those produced by agents which induce indiscriminate tissue catabolism. Preliminary results are presented. (C.H.)

9566 TID-3028

Technical Information Service, AEC.

THORIUM TOXICOLOGY. A List of Selected References. Hugh E. Voress, comp. May 28, 1952. Decl. March 5, 1959. 10p. \$1.80(ph), \$1.80(mf) OTS.

This bibliography consists of 21 annotated references on Th toxicology. The subjects covered include the effects of thorium on both laboratory animals and man, from the standpoint of chemical and radioactive toxicity. Some information on tolerance calculations and permissible limits is also included. (auth)

9567 UR-539

Rochester, N. Y. Univ. Atomic Energy Project. STUDIES ON LARGE AREA SUB-FABRIC BURNS: THE EFFECT OF AN AIR SPACE BETWEEN A TWO LAYER SYSTEM. Kelly M. Berkley. Jan. 14, 1959. 18p. Contract W-7401-eng-49. \$0.75(OTS).

It is well known that protection against radiant energy burns afforded by fabrics may be increased by creating an air space between the fabric and the underlying skin. Earlier work in this laboratory has also shown that if one layer of fabric is in contact with skin, protection of a two-layer fabric system increases progressively as the space between the fabrics changes from two to five millimeters. With the magnesium source, large area sub-fabric burns were produced to determine the effects of still greater air spaces between the two layers. With underwear material in contact with the skin of white pigs, green poplin material was placed either in contact with or at distances of from one to four centimeters from the underwear. Magnesium flash powder, in 150 gm charges, was exploded at a distance of 20 cm from the animals. It was found that combinations of fabric and spacing which resulted in the underwear's remaining intact resulted in the greatest protection. In general, fire-retardant treated material was superior to untreated material, and increasing the air space between the two layers decreased severity of the resulting burns. (auth)

9568 AEC-tr-3569

BIOLOGICAL EFFECT OF IONIZING RADIATIONS, AGING PROCESSES AND LIFETIME. V. I. Korogodin and G. G. Polikarpov. Translated by Lydia Venters (Argonne National Lab.) from Med. Radiol. 3, No. 4, 79-85(1958). 12p. \$3.30(ph), \$2.40(mf) JCL or LC.

A review covering the past twenty or thirty years is presented. 89 references. (W.L.H.)

9569 AEC-tr-3585

SOME MEDICAL AND BIOLOGICAL APPLICATIONS OF CHELATE COMPLEXES. (Einige Medizinische und Biologische Anwendungen von Chelat-Komplexen.) Jack Schubert. Translated for Argonne National Lab. from *Chimia* (Switz.) 11, 113-24(1957). 36p. \$6.30(ph), \$3.00(mf) JCL or LC.

The drug actions of chelates are considered. It is pointed out that the discussion is speculative; however, the interpretations of drug actions involve such an enormous number of factors that it is useful to utilize a generalization such as chelation which correlates group pharmacological action of apparently unrelated compounds. Metal chelate behavior in accelerating excretion of radioactivity and in metal poisoning are discussed, as well as the application of chelation in antipyresis and rheumatic fever. In addition, the chelating properties of anti-tumor drugs are considered along with those for drugs successfully used in tuberculosis. The antihypertensive effects of some chelating agents are discussed as well as chelation and metal activation of enzymes. A summary of the theory of the ternary complex and its relation to drug action is presented. (J.R.D.)

9570

LATE EFFECTS OF TOTAL-BODY ROENTGEN IRRADIATION. III. EARLY APPEARANCE OF NEOPLASMS AND LIFE-SHORTENING IN FEMALE WISTAR RATS SURVIVING 1000 r HYPOXIC TOTAL-BODY IRRADIATION. Baldwin G. Lamson, Marta S. Billings, Ray A. Meek, and Leslie R. Bennett (Univ. of California, Los Angeles). *A.M.A. Arch. Pathol.* 66, 311-21(1958) Sept.

Eighty-three female Wistar rats surviving a single exposure to 1000 r hypoxic total-body irradiation at 4 months of age and eighty-four controls of the same stock were observed throughout their life span. The irradiated animals were all dead two years after irradiation, with a mean survival of 15 months. This represents a 39% shortening of postirradiation life span, compared to the 24.5-month mean survival of the controls. This reduction of life span following hypoxic irradiation is comparable to that reported in rodents following total-body irradiation in air, if the dose is expressed in each case as a per cent of the LD₅₀ dose. Irradiated rats were also retarded in growth, weighing approximately 18% less than the controls 20 months post irradiation. All irradiated rats surviving at least 9.5 months developed cataracts, with a mean appearance time of 10.5 months. Aged control rats also acquired cataracts, appearing first at 26.5 months. Eighteen irradiated rats developed severe bilateral nephrosclerosis, a disease not observed in the controls. Large pituitary adenomas were common in the controls but absent in the irradiated group. Other major pathologic findings in the irradiated rat were closely similar to those found in control rats of advanced age. Tumors, as a whole, appeared sooner in the irradiated rats but not in greater final numbers. The incidence of tumors in both irradiated and control series generally followed the pattern characteristic of the animal strain, with reproductive and endocrine loci predominating. Ovarian tumors appeared to be specifically increased by the irradiation exposure. Lymphomas were not increased or accelerated by radiation under these conditions in this low-incidence strain. In general, the early onset of neoplasia in the irradiated rat seems best explained as one

aspect of an accelerated aging process. Other diseases prevalent in aged rats, such as cataracts, acute inflammations, epilation, and skin ulcerations, were similarly accelerated to a comparable degree. (auth)

9571

LATE EFFECTS OF TOTAL-BODY ROENTGEN IRRADIATION. IV. HYPERTENSION AND NEPHROSCLEROSIS IN FEMALE WISTAR RATS SURVIVING 1000 r HYPOXIC TOTAL-BODY IRRADIATION. Baldwin G. Lamson, Marta S. Billings, Leroy H. Ewell, and Leslie R. Bennett (Univ. of California, Los Angeles). *A.M.A. Arch. Pathol.* **66**, 322-9(1958) Sept.

Systolic blood pressure levels were studied in 59 female Wistar rats surviving 1000 r hypoxic total-body irradiation and in 63 controls of the same age. Mean blood pressure of the irradiated rats at monthly intervals from 13 to 23 months post irradiation averaged 39 mm Hg greater than the controls of the same age. Forty-six per cent of the irradiated rats also developed bilateral nephrosclerosis. The mean value of maximal blood pressure determinations from individual rats was 193 mm Hg in the irradiated group, compared to 139 mm Hg in the controls. Mean blood pressure maxima in the irradiated rats without severe renal disease was almost as high as in those with nephrosclerosis. No correlation between duration of hypertension and eventual development of nephrosclerosis could be made, but rats with nephrosclerosis in no case had normotensive histories. (auth)

9572

EFFECTS OF RADIOCOBALT IRRADIATION OF UNFERTILIZED OR FERTILIZED RABBIT OVA IN VITRO ON SUBSEQUENT FERTILIZATION AND DEVELOPMENT IN VIVO. M. C. Chang, Dorothy M. Hunt, and E. B. Romanoff (Worcester Foundation for Experimental Biology, Shrewsbury, Mass. and Boston Univ.). *Anat. Record* **132**, 161-79(1958) Oct.

Freshly shed rabbit ova recovered from the Fallopian tubes were irradiated with a radiocobalt source at 45 r to 32,000 r and then transplanted into the left tube of mated rabbits. The ova were recovered and examined microscopically 10 hours to 24 hours, two days and 6 days after transplantation for the determination of fertilization, cleavage, and blastocyst formation. The fetus and uterine contents were examined macroscopically 22 to 25 days after transplantation. The proportion of fertilized ova decreased from 71% at a very low dosage, 45 r, to 46% at a very high dosage, 32,000 r. The proportion of normally cleaved ova and normal blastocysts decreased from about 95% at 45 r, to about 3% at 800 r, to 0% at 6,500 r. The proportion of embryonic development decreased from 49% at 45 r, to 21% at 80 r, to 0% at 800 r. A chromosomal bridge was observed in an ovum irradiated at 6,500 r. Failure of second polar body division in one out of 23 ova irradiated at 6,500 r and polyspermy in one out of 32 ova irradiated at 32,000 r before fertilization was observed. When fertilized rabbit ova at the two cell stage were irradiated at 45 r to 6,500 r and examined at various times after transplantation, it was found that the proportion of normal cleavage decreased from 76% at 45 r to 33% at 800 r, to 0% at 6,500 r. The proportion of normal blastocysts decreased from 61% at 45 r, to 20% at 800 r, to 0% at 6,500 r. The proportion of normal embryonic development decreased from 46% at 45 r, to 12% at 800 r, to 0% at 6,500 r. In combination with data from a previous study of the irradiation of rabbit sper-

matozoa in vitro the following points are revealed: No abnormal fetus, no high proportion of degeneration after implantation, and no disturbance of the sex ratio were observed whether spermatozoa, or ova, unfertilized, or fertilized, were irradiated from 45 r to 800 r. Although there may be a differential sensitivity to various dosages for the subsequent cleavage and blastocyst formation following the irradiation of spermatozoa, unfertilized or fertilized ova at 45 r to 6,500 r, as far as subsequent embryonic development is concerned, the spermatozoa are more radioresistant than either unfertilized or fertilized ova and the unfertilized ova are more radiosensitive than fertilized ova. The chemical constituents of gametes necessary for the future development of the zygotes are more radiosensitive than are those for their fertilization and other activities. (auth)

9573

PARAMETERS OF ASCITES TUMOR GROWTH. Harvey M. Patt (Argonne National Lab., Lemont, Ill.). *Ann. N. Y. Acad. Sci.* **76**, 572-4(1958) Dec. 5.

Ascites tumors, because of their analytical convenience and biological flexibility, represent an adaptation important for study of growth. Such tumors, like all transplantable tumors, may be subject to influences not operative in the development of naturally occurring neoplasms. The ascitic form of growth is nevertheless particularly useful in that patterns of cell proliferation can be studied directly under a variety of conditions and, by contrast with the corresponding solid growth, variables of organization and vascularization can be evaluated. Applications and advantages of ascites tumors for chemotherapeutic screening are discussed. Although, superficially, ascites tumors would appear to represent a simple system for chemotherapeutic screening, as in the case of solid tumors, there are many uncertainties concerning the relationships between tumor growth and host response. (C.H.)

9574

THE ADSORPTION OF STRONTIUM ON HYDROXY-APATITE CRYSTALS. M. D. Morachevskaya, V. S. Zlosin, and B. V. Ptitayn (Technological Inst. of the Food Industry, Leningrad). *Biochemistry (USSR) (English Translation)* **23**, 528-31(1958) July-Aug.

The adsorption of strontium-89 on crystals of hydroxyapatite from water solution and gastric juice was studied. Adsorption of strontium by hydroxyapatite from acid solution at strontium concentrations in the solution of 2.5×10^{-7} to 5×10^{-8} M is small. When sodium bicarbonate or disodium phosphate are added to the solution, strontium is removed from the solution almost completely. When radiostrontium enters the stomach its removal may be effected by the administration per os of a water suspension of 10 to 20 g of hydroxyapatite with addition of 1 to 2 g of Na_2HPO_4 . (auth)

9575

THE LAW OF RECIPROCITY AND THE BIOLOGICAL EFFECTS OF FAST ELECTRONS. Ya. L. Shekhtman, G. B. Radzievskii, A. A. Zotikov, and P. Ya. Glazunov (Inst. of Biophysics, Academy of Sciences of the USSR, Moscow). *Biophysics (USSR) (English Translation)* **3**, 298-304(1958).

Data are presented from a study of fast electron dose rate effects on wheat seedlings. The results show that changing the irradiation time by a factor of 130,000 gives no deviation from reciprocity, to ± 5 per cent.

A comparison with previous data for the same object given long x irradiations where deviations from reciprocity were observed indicates that the plant seedlings recover extremely slowly, so that no deviation from reciprocity is found. (C.H.)

9576

THE ELECTRICAL CONDUCTIVITIES OF LIVER AND SPLEEN HOMOGENATES IN RADIATION INJURY. A. I. Polivoda and A. A. Zolotova. Biophysics (USSR) (English Translation) 3, 304-8(1958).

Depolymerization-type processes occur in the livers and spleens of irradiated rats; these are accompanied by an increase in conductance and the loss of impedance dispersion. The changes appear particularly clearly in the light fraction of the homogenates, and are very marked very soon after lethal doses of Co^{60} γ rays. The lack of dispersion and the anomalous conductance variation with dilution indicate that the dipole moments of some molecular structures must have been altered. (auth)

9577

THE FUNCTIONAL RADIOSENSITIVITY OF CHLOROPLASTS. A. M. Kuzin, Sun Chi, and G. N. Saenko (Inst. of Biophysics, Academy of Sciences of the USSR, Moscow). Biophysics (USSR) (English Translation) 3, 308-14(1958).

The effects of ionizing radiation on the photosynthetic activities of chloroplasts in intact leaves from *Tradescantia*, tobacco, and bean have been studied. The photosynthetic activity was determined from the rate of uptake of C^{14}O_2 . The chloroplasts have been shown to be functionally highly radiosensitive. Twenty kr produced no effect on any of the plants, but 50 kr affected the *Tradescantia*. Leaves are more radiosensitive and show reduced activity. The activity reduction became greater with the passage of time and was very marked at 24 to 48 hr after irradiation. The chloroplasts in young leaves were more radiosensitive than those in old ones. The low radiosensitivity of the photosynthetic activity in chloroplast is considered to be due to the low nucleic acid content. Nucleic acid determinations on pure isolated chloroplasts show that more nucleic acid is present in the more radiosensitive young leaves. (auth)

9578

RADIATION PROTECTION AGENTS AND MORTALITY PEAKS. N. V. Luchnik (Inst. of Biology, Urals Branch of the Academy of Sciences of the USSR, Sverdlovsk). Biophysics (USSR) (English Translation) 3, 314-23(1958).

Experiments on the effects of various chemical and biological materials on the mortality peaks appearing in the post-irradiation death distribution are described. Mice irradiated with Co^{60} γ rays were used. The protective action of 80 agents was tested on the first and second peak at 1000 r in the main experiment. Of these, 8 selectively reduced the first peak, 11 the second, and 11 both. A similar picture is obtained at lower doses, at which five peaks appear. Some agents reduce all five, others are somewhat selective. It is concluded that the peaks reflect different ultimate causes of death, and that the various protection agents act in different ways. (auth)

9579

THE DYNAMIC RADIATION INJURY IN CALANDRA GRANARIA UNDER VARIOUS IRRADIATION CONDITIONS. G. V. Sumarokov (Lomonosov State Univ.,

Moscow). Biophysics (USSR) (English Translation) 3, 359-61(1958).

The effects of ionizing radiation on adult insects were studied following exposure of the beetle, *Calandra granaria*, during the developing stage to various doses of cobalt-60 radiation under normal conditions and in air with varying amounts of oxygen. Death of the insects served as the indicator of radiation injury. Data are summarized from three repeated tests in which 25,000 insects were used. (C.H.)

9580

IRRADIATION OF THE ENTIRE BODY AND MARROW TRANSPLANTATION: SOME OBSERVATIONS AND COMMENTS. E. Donnal Thomas, Harry L. Lochte, Jr., and Joseph W. Ferrebee (Mary Imogene Bassett Hospital, Cooperstown, N. Y. and Children's Cancer Research Foundation, Boston). Blood 14, 1-23(1959) Jan.

Case reports of 5 patients with acute leukemia receiving total-body irradiation and intravenous infusion of normal marrow are presented. An eight-month follow-up on a previously reported patient with chronic leukemia is included and a review of an individual receiving nitrogen mustard and marrow is presented for comment. Of several patients reported in this and in a previous communication only two may be said to have obtained significant clinical benefit. Potential reasons for this incidence of improvement are advanced and the general subject of total-body irradiation and marrow replacement in man is discussed. Pitfalls and problems biologic and physical and the theory of their circumvention are analyzed. (auth)

9581

EFFECTS OF VERY LOW DOSES OF X RADIATION (5 r), RECEIVED AT BIRTH, ON LEUKEMIA INDUCTION IN THE MOUSE. Georges Rudali and Jean Reverdy. Compt. rend. 248, 1248-9(1959) Feb. 23. (In French)

The irradiation of newly born mice, aged 12 to 18 hr, with a dose of 5 r noticeably shortens the latency of spontaneous leukemia. (tr-auth)

9582

EFFECTS OF IONIZING RADIATION ON THE CONTENT OF FREE NUCLEOTIDES AND NUCLEOSIDES OF MARROW. V. Ya. Brodskii, E. Ya. Graevskii, and I. A. Suetina (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 124, 440-3(1959) Jan. 11. (In Russian)

Experiments with 73 6- to 8-week old mice weighing 18 to 22 g and exposed to 700 r at 22 cm distance (with the whole-body, right side, lower back, and screened lower back extremities) showed that the number of nucleotides drops after 6 hours following direct or screened exposures. Almost identical results were observed in local and nonlocal irradiations. It was concluded that while destructive processes and disturbances in cell division depend on local irradiation, the drop in the number of free nucleotides and nucleosides is a factor of nonlocal effects. (R.V.J.)

9583

EFFECTS OF IRRADIATED MEDIA ON THE SPLEEN TISSUE TRANSPLANTATION. A. F. Ivanitskaya (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 124, 444-7(1959) Jan. 11.

The participation and effects of plasma media irradiated with 5000 and 100,000 r γ rays on cell growth in spleen section transplantation were studied. The

medium irradiated with 100,000 r was used the same day, the next, and 2 days later. The results showed that the irradiation of media (extract and plasma) with 100,000 r affects the growth and behavior of nonirradiated mouse spleen, produces toxic effects in the growing culture cells, and induces serious disturbances in the blood cells, especially lymphocytes. The connecting tissue cells are also badly afflicted. In the medium irradiated with 5000 r the free blood cells undergo pathological changes and are destroyed on the second day following the exposure, while the reticular elements retain their morphological and functional properties and the changes which might take place do not affect general functions of the tissue as a whole. The lymphoid group of the three basic spleen cells (lymphoid, granular and reticular) is the first affected and the last to restore itself. (R.V.J.)

9584

EFFECTS OF IONIZING RADIATION ON PARAMECIUM CULTIVATION AT VARIOUS TEMPERATURES. I. B. Litvinova (Inst. of Animal Morphology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 124, 448-51(1959) Jan. 11.

An analysis was made of the disturbances and regenerative processes taking place in irradiated cells at various temperatures. The data indicate the depressing effects of 100-r irradiation on the division rate of infusoria. The subsequent regenerative processes depend directly on the temperature of paramecium cultivation after exposure. It was concluded that restoration depends on the temperature much more than the depression. The experiments also showed that radiation depression and restoration of cell division depend less on the temperature than the normal processes of infusoria reproduction. (R.V.J.)

9585

THE EFFECT OF POSTIRRADIATIONAL TEMPERATURE ON THE REACTION OF PARAMECIA PRODUCED BY DIFFERENT DOSES OF IONIZING RADIATION. I. B. Litvinova (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 124, 678-80(1959) Jan. 21. (In Russian)

Studies of temperature effects on the rate of cell division and survival of paramecium irradiated with 150 to 300 r at 3 to 4°C with incubation at 12, 21, and 28°C showed that an increase of incubation temperature shortened the time interval before cell division began. The survival of infusoria after the first day following irradiation was reduced. Tabulated data of the survival of paramecium at various incubation temperatures and doses showed that radiation injuries increase with lowered cultivation temperature. Hence, the data confirms the previous assertion that recuperation processes depend on temperature more than on initial injuries. (R.V.J.)

9586

ON NUCLEAR INJURIES IN DORMANT CELLS OF AN ANIMAL ORGANISM, PRODUCED BY IONIZING RADIATION. I. M. Shapiro (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 124, 681-4(1959) Jan. 21. (In Russian)

Experiments were carried out in order to determine the changes in chromosome disturbances in white mice dormant liver cells at various periods after exposure to 500 r. (R.V.J.)

9587

THE NATURE OF THE DEPENDENCE RELATION OF THE FREQUENCY OF LETHALS ARISING AT DIFFERENT STAGES OF SPERMATOGENESIS ON THE DOSE OF X-RAYS. M. L. Belgovskii, E. A. Abeleva, and N. A. Potekhina. Doklady Akad. Nauk S.S.S.R. 124, 922-4(1959) Feb. 1. (In Russian)

A series of special experiments was carried out in order to find the dependence of the frequency of lethals arising in *Drosophila melanogaster* (Algerian and Ebree) mature sperm, spermatides, and spermatogenesis on dose from 1000 to 4000 r. The tabulated data show that the frequency of lethals in spermatides induced by 4000 r increased by a factor of 1.4. However, in mature sperms the increased dosage induces a linear increase in the frequency of lethals. (R.V.J.)

9588

THE EFFECT OF EXPOSURE TO X-RAYS ON THE CONTENT OF NITROGENIC SUBSTANCES IN WHEAT PLANTS. I. M. Vasil'ev, O. I. Parfenova, and N. D. Rybalka (Inst. of Biological Physics, Academy of Sciences, U.S.S.R.). Doklady Akad. Nauk S.S.S.R. 124, 928-9(1959) Feb. 1. (In Russian)

Under favorable conditions of photosynthesis, irradiation does not depress the wheat plant accumulations of cyclic amino acids and nucleotides. However, the growth of the plant is depressed, and at 3000 r it is completely arrested. (R.V.J.)

9589

THE EFFECT OF CHRONIC IRRADIATION UPON BLOOD IN MICE. E. N. Kopylova (Inst. of Genetics, Academy of Sciences, U.S.S.R.). Doklady Akad. Nauk S.S.S.R. 124, 930-2(1959) Feb. 1. (In Russian)

The effects of chronic irradiation by small doses of γ rays on the peripheral blood in animals were studied. Daily exposures to doses of 0.05 r induced mild leukopenia after 3 months, and doses of 0.4 r induced a sharp drop in leukocytes after 6 months daily exposures to 0.1 r induced regenerative changes in the white blood cells following a year of exposure. No changes were observed in red blood. (R.V.J.)

9590

DEMONSTRATION OF THE CONCENTRATION OF ASTATINE-211 IN THE MAMMARY TISSUE OF THE RAT. C. Willet Asling, Patricia W. Durbin, Muriel E. Johnston, and Marshall W. Parrott (Univ. of California, Berkeley). Endocrinology 64, 579-85(1959) Apr.

Concentration of At^{211} in the mammary tissue of virgin and lactating female rats has been demonstrated both by gross radioactive assay and by autoradiography. Secretion of At^{211} in the milk was shown by its presence in the gastrointestinal tracts and carcasses of nurslings and by the presence of alpha-particle tracks in glandular lumens in autoradiographs. In virgin mammary tissue At^{211} was chiefly associated with the parenchyma, although small amounts could also be found in the stroma. (auth)

9591

THE X-RAY INDUCTION OF LYTIC UNITS IN *ESCHERICHIA COLI* B. F. Hercik (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague) 4, 65-74(1958).

Bacteria of the strain *E. coli* B irradiated with small doses of x radiation (52 to 60 kv) release a transmissible lytic principle which acts on the homologous strain of *E. coli* B. The action of the lytic principle may be exhibited in the first or in later passages.

The optimal dose is 30 r. It was demonstrated experimentally that the strain of *E. coli* used in these experiments is not lysogenic. In the electron microscope bacteriolysis was found, with the occurrence of regular globules and occasionally of larger particles measuring 60 to 70 μ . The different conditions for successful induction were studied, but the lysis percentage could not be raised above 50%. The incidence of the phenomenon is not regular and is evidently chiefly dependent on the physiological state of the bacteria. (auth)

7592

THE QUESTION OF INDIRECT INFLUENCES IN THE REACTION OF RAT EMBRYOS TO IRRADIATION.

A. Lengerova (Inst. of Biology, Czechoslovak Academy of Sciences, Prague). *Folia Biol. (Prague)* **4**, 75-82 (1958).

When the total number of rat embryos was irradiated in utero, the reaction was stronger than when only half were irradiated. This was displayed in higher prenatal mortality and a lower mean body weight. When irradiated shortly before birth, rat fetuses reacted significantly less intensely than newborn rats irradiated with the same dose. This may be due either to the protective influence of the maternal organism, or to higher radio-resistance of the fetuses in utero, due to their different physiological state, or to both these influences. Irradiation of the female with a sublethal radiation dose on the 15th day of gestation markedly enhanced the lethal effect of a simultaneous dose of 200 r on the fetuses. Splenectomy of the female did not affect the reaction of the fetuses to a dose of 200 r on the 15th day of gestation. (auth)

7593

CHANGES IN THE MEAN VOLUME OF THE RED BLOOD CELLS FOLLOWING X-RAY IRRADIATION IN VIVO. M. Pospíšil (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). *Folia Biol. (Prague)* **4**, 215-19(1958).

Changes in the mean volume of the red blood cells in rabbits were studied by the hematocrit method over a period of ten days following a single total-body dose of x rays (200, 600, 800, 1,000, and 1,400 r). A definite relationship exists between variations in the total number of cells and variations in the mean red cell volume. An increase in the total number of red cells is accompanied by a decrease in their volume, and vice versa. Post-irradiation changes in the red cell volume are dependent on the initial (pre-irradiation) value. High initial values decrease after irradiation, and vice versa. This is reminiscent of Wilder's law of initial values. On comparing groups with the aim of determining the relationship between the above changes and the dose and survival, it is important to compare groups with the same initial value. As the dose is increased, the mean red cell volume shows a corresponding tendency to decrease. A comparison of groups of surviving and non-surviving animals showed a greater decrease in the mean red cell volume in the nonsurviving animals. (auth)

7594

CONTRIBUTION TO THE QUESTION OF THE SCATTERED RADIATION DAMAGE TO THE PATIENT WITH TUBE VOLTAGES OF 60 TO 180 KV.

A. Schaal (Siemens-Reiniger-Werke AG, Erlangen, Ger.). *Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed.* **90**, 247-51(1959) Feb. (In German)

The change of scatter doses in a water phantom with change of kilovoltage was investigated for the same exit dose from 60 kv to 180 kv. The measurements were carried out with and without a bucky on 10 cm and 20 cm thick phantoms. When a bucky was used, scatter was found to decrease considerably near the field of incidence and little at greater distances. Without a bucky, however, a smaller decrease of scatter dose near the field of entrance was observed, while near the exit side an increase of scatter dose was found to occur. When 150 kv with a bucky was compared with 60 kv without a bucky, the higher kilovoltage was found to produce an increase in scatter doses. Voltages above 150 kv do not reduce patient dose. (auth)

7595

EFFECTS OF X-RAYS ON CHROMOSOMES OF *LILIUM LONGIFLORUM* DURING MEIOSIS. Sandhya Mitra (Columbia Univ., New York). *Genetics* **43**, 771-89(1958) Nov.

A study has been made on the effects of x rays on chromosomes in the anthers of *Lilium longiflorum* at various stages of meiosis. Cells ranging in stage of nuclear development from premeiotic interphase to metaphase I were irradiated with doses of 15 to 60 r units. Observations are described. (C.H.)

7596

ACUTE RADIATION RESPONSE OF MICE FROM A CROSS BETWEEN RADIOSENSITIVE AND RADIORESISTANT STRAINS. Douglas Grahn (Argonne National Lab., Lemont, Ill.). *Genetics* **43**, 835-43(1958) Nov.

The acute lethal response to whole body x irradiation of F_1 , F_2 , and F_3 generations from parent strains BALB/c and C57BL/6 is shown to manifest both nonadditive and additive genetic effects. The variance of sensitivity, measured by the dosage-mortality slope, is additive. The $LD_{50/30}$ dose is nonadditive. It is suggested that the nonadditive component may be primarily a heterotic expression. No maternal influence or sex linkage is detected in the acute response. Radiosensitivity is associated with the albino gene, although the data do not permit discrimination between pleiotropism or linkage as the basis of this association. In the F_2 , the genetic component of variance (heritability) accounts for about 55 percent of the variation in radiation sensitivity. (auth)

7597

THE NATURALLY OCCURRING α -RAY ACTIVITY OF FOODS. R. C. Turner, J. M. Radley, and W. V. Mayneord (Royal Cancer Hospital, London). *Health Phys.* **1**, 268-75(1958) Dec.

Most of the activity is due to members of the thorium and radium series. There is a factor of 20,000 between the most active and least active foods. The most active food so far measured is the Brazil nut; breakfast cereals have the next highest α activity. In general, values in milk products, fruits, and vegetables are low. The α activity seems to increase with the phosphorus content of foods. In general, an adequate diet will not contain less than 2×10^{-12} c of α /day. (auth)

7598

APPLICATIONS OF AN ANALOG COMPUTER TO ANALYSIS OF DISTRIBUTION AND EXCRETION DATA. B. R. Fish (Oak Ridge National Lab., Tenn.). *Health Phys.* **1**, 276-81(1958) Dec.

The work of the ORNL Health Physics Division in studying various mathematical models for the distribution and excretion of uranium following intravenous in-

jection has been greatly facilitated by the use of an electronic analog computer. A four compartment linear model appeared to be adequate to explain data obtained from male rats and low-dose level human data. However, to simulate human excretion following injection at higher dose levels, it was necessary to superimpose a saturable excretion pathway upon the linear model. A prime object of the model work has been the derivation of some means whereby field measurements of excretion may be related to internal dose. That object has been realized in the inverse model by comparing the model output with the excretion data to obtain an error function which is used to drive the model. (auth)

9599

BREMSSTRAHLUNG COUNTING OF Sr^{90} INJECTED DOGS. C. W. Mays, D. H. Taysum, W. Fisher, and B. W. Glad (Univ. of Utah, Salt Lake City). Health Phys. 1, 282-7(1958) Dec.

Strontium retention was measured in dogs injected with Sr^{90} by whole-body bremsstrahlung counting. For young adult beagles 17.7 months old at injection, fractional strontium retention may be expressed as $R = 0.68t^{-0.21}$ where t is the number of days after injection. This is slightly less than fractional radium retention measured in beagles of similar injection age at this laboratory. A method was developed in which low levels of Sr^{90} in living dogs can be determined by bremsstrahlung counting with a standard deviation of less than 0.1 μc . (auth)

9600

MAXIMUM PERMISSIBLE AMOUNTS OF NATURAL URANIUM IN THE BODY, AIR AND DRINKING WATER BASED ON HUMAN EXPERIMENTAL DATA. S. R. Bernard (Oak Ridge National Lab., Tenn.). Health Phys. 1, 288-305(1958) Dec.

The distribution of uranium in the human body following intravenous injections of hexavalent and tetravalent uranium was studied in the case of eight terminal patients. At the dosage levels used the data indicate that the kidneys and the skeleton are the principal sites of deposition with approximately equal amounts in each. On this basis, the kidneys become the critical organ and the toxic effect of the uranium rather than radiation damage becomes the limiting effect in determining the maximum permissible concentrations (m.p.c.) for occupational exposure. The influence of particle size on retention of inhaled material is considered in interpreting some of the available human data. (auth)

9601

THE USE OF RADIOISOTOPES IN THE U.S.S.R. G. V. Kurdyumov, M. B. Neimen, and G. M. Frank (Academy of Sciences of the U.S.S.R., Moscow). Intern. J. Appl. Radiation and Isotopes 5, 1-14(1959) Feb.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 10283.

9602

NITROGEN FIXATION BY THE ACTION OF IONIZING RADIATIONS. S. Ya. Sahezhetskii and M. T. Dmitriev (Academy of Sciences of the U.S.S.R., Moscow). Intern. J. Appl. Radiation and Isotopes 5, 67-9(1959) Feb.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 9062.

9603

THE MECHANISM OF RADIATION PROTECTION BY HISTAMINE AND OTHER BIOLOGICAL AMINES. C. van der Meer and D. W. van Bakkum (National Defence Research Council T.N.O., Rijswijk (Z.H.), The Netherlands). Intern. J. Radiation Biol. 1, 5-23(1959) Jan.

The radioprotective activity of a number of biological amines, among them histamine and epinephrine, has been shown to be related to their pharmacological activity in mice. Pharmacological antagonists were found to counteract the protective activity of these compounds. The protective effect could not be correlated with the effects of the amines on the blood pressure. By the use of a polarographic technique it could be shown that the protective compounds cause a decrease of the oxygen tension in the spleen, the magnitude and duration of which is correlated to the degree of radioprotection. Similarly, a reduction of the oxygen content of the inspiratory air reduces the oxygen tension in the spleen and affords protection against irradiation. It is concluded that histamine, epinephrine, and a number of other biological amines protect against irradiation by reducing the oxygen tension in the spleen and possibly in other blood forming organs. (auth)

9604

5-HYDROXYTRYPTAMINE AS A RADIATION PROTECTIVE SUBSTANCE IN ANIMALS. H. Langendorff, H.-J. Melching, and H.-A. Ladner (Univ. of Freiburg, Baden, Ger.). Intern. J. Radiation Biol. 1, 24-7(1959) Jan.

This is a report describing the protection of 5-hydroxytryptamine against the effects of ionizing radiation among mice. The results show a good degree of protection if 5-hydroxytryptamine is applied before irradiation. The effect is greater than that found among other substances known today. (auth)

9605

THE DNA CONTENT OF THE SMALL INTESTINE AS A QUANTITATIVE MEASURE OF DAMAGE AND RECOVERY AFTER WHOLE BODY IRRADIATION. R. H. Mole and Diana M. Temple (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Intern. J. Radiation Biol. 1, 28-42(1959) Jan.

The total amount of deoxyribonucleic acid (DNA) in the small intestine was used as a measure of cell population in order to follow the course of radiation damage in mice and rats. Changes in total DNA-P were proportionately larger and intrinsically less variable than changes in fresh weight of the intestine. In unirradiated control mice intestinal DNA-P concentration was constant but intestinal weight and total intestinal DNA-P were linearly dependent on body weight. Single doses of whole-body irradiation given to mice caused a fall in total intestinal DNA-P which began 12 hours later. Except after 25,000 r which had less effect than 5000 r, the larger the dose of radiation the greater the maximum depression in DNA-P and the later the time at which recovery began. The course of recovery was exponential after 1000 r but not after 750 r. In both rats and mice β -mercaptoethylamine reduced the damaging effect of a dose of radiation but did not modify the course of recovery. Chronic irradiation of mice at levels sufficient to reduce body weight slightly caused a loss in total intestinal DNA-P. The loss was probably, but not certainly, greater than that expected from the loss in body weight alone. (auth)

7606

DNA SYNTHESIS IN THE THORACIC-DUCT LYMPHOCYTES OF RATS DURING RECOVERY FROM SUB-LETHAL IRRADIATION. E. H. Cooper (Univ. of Oxford). Intern. J. Radiation Biol. **1**, 43-51(1959) Jan.

Total-body irradiation of rats with doses of x rays between 75 and 300 r produced a profound depression in the output of lymphocytes from thoracic-duct fistulae. Initially after the irradiation the percentage of large lymphocytes in the thoracic-duct lymph was decreased. During the recovery phase after a dose of 300 r, there was a marked increase in the percentage of large lymphocytes. DNA-synthesis in the large lymphocytes was studied by P^{32} incorporation *in vivo* and by the incorporation of tritiated thymidine *in vitro*. Following irradiation there was an increased number of large lymphocytes synthesizing DNA in unit time. The mechanism of this change is discussed. (auth)

7607

HEXOKINASE, ALDOLASE AND ATP-CREATINE TRANSPHOSPHORYLASE IN X-IRRADIATED RATS. M. B. Sahasrabudhe, M. K. Nerurkar, and A. J. Baxi (Atomic Energy Establishment and Indian Cancer Research Centre, Bombay) and D. K. Mahajan (Indian Research Centre, Bombay). Intern. J. Radiation Biol. **1**, 52-60(1959) Jan.

The influence of 600 r total-body x irradiation on the hexokinase, aldolase, and ATP-creatine transphosphorylase activities and the levels of lactic acid in spleen, skeletal muscle, brain, and liver of rats have been investigated. Hexokinase and aldolase were shown to be lowered following irradiation in all the tissues studied. Maximum changes were noticed in rats sacrificed 2 hours after irradiation. No noticeable changes were observed in the ATP-creatine transphosphorylase activity of irradiated rats. Evidence is presented to show that the lowering of the hexokinase and aldolase activities of irradiated animals is not due to release of any inhibitory substance in the body. The radiation-impaired hexokinase activity could not be regained by fortification of the incubation medium with ascorbic acid. The inhibitory effects on aldolase activity could be reversed, to some extent, by addition of ferrous iron to the incubation mixture. Levels of lactic acid decreased in different tissues of x-irradiated rats suggesting decreased glycolysis and/or elevated glyconeogenesis. Possible implications of the results are discussed. (auth)

7608

ON THE RELATIVE ROLE OF MUTATION AND RECOMBINATION IN RESPONSES TO SELECTION FOR POLYGENIC TRAITS IN IRRADIATED POPULATIONS OF *D. MELANOGASTER*. R. E. Scossioli and S. Scossioli (Univ. of Pavia, Italy). Intern. J. Radiation Biol. **1**, 61-9(1959) Jan.

X-ray treatments are a very efficient tool for inducing polygenic mutation and therefore additive genetic variability for polygenic traits in *Drosophila*. Artificial selection can make use of the new genetic variability. X-ray-induced increase in recombination rates does not seem to be an important factor in determining the observed effects, at least in the described experiments. (auth)

7609

AN ATTEMPT TO ASSESS THE ACTIVITY OF TUMOUR CELLS BY THE STUDY OF NUCLEOLAR MORPHOLOGY, MITOTIC INDEX AND PHOSPHORUS WITH ^{32}P . S. Mitra, P. De, R. Chatterjee, K. Bhattacharya,

A. Bose, and H. Dutta (Chittaranjan National Cancer Research Centre, Calcutta). Intern. J. Radiation Biol. **1**, 70-2(1959) Jan.

A technique has been established for the determination of P^{32} uptake of the average tumor cell. A correlation was observed between nucleolar morphology, mitotic index, and P^{32} uptake of an average tumor cell of a particular type of tumor. All the above factors increased consistently from the benign tumor to adenocarcinoma which retains some amount of differentiation in the form of persistent acinar space and finally of carcinoma simplex where the differentiation is minimum. (auth)

7610

THE INACTIVATION OF SH ENZYMES BY X-RAYS.

Rolf Lange, Alexander Pihl, and Lorentz Eldjarn (Norwegian Radium Hospital, Oslo). Intern. J. Radiation Biol. **1**, 73-9(1959) Jan.

The susceptibility of SH enzymes to the indirect effect of ionizing radiation has been re-investigated. The claims of previous authors that these enzymes are particularly radiosensitive could not be confirmed. Dilute solutions of crystalline glyceraldehyde-3-phosphate dehydrogenase and yeast alcohol dehydrogenase were found to be inactivated by x rays, with ionic yields of about 0.02. In contrast to previous reports no reactivation was obtained by the addition of reduced glutathione after the irradiation. The discrepancy between the present results and those of earlier investigators can in part be explained by the fact that the earlier estimations of ionic yields were based on molecular weights for the enzymes which differ by a factor of about 2 from those currently accepted. The present data seem to be consistent with a number of radiochemical and enzymological findings. (auth)

7611

X-RAY-INDUCED ABNORMAL DIFFERENTIATION OF THE EPITHELIUM OF THE SMALL INTESTINE IN THE MOUSE. Richard A. McGrath and C. C. Congdon (Oak Ridge National Lab., Tenn.). Intern. J. Radiation Biol. **1**, 80-5(1959) Jan.

After 2500 r of x irradiation of intestinal epithelium the cells that originally occupied the crypts (stem cells) migrate onto the villus. These abnormal stem cells form the final protective barrier between intestinal lumen and the tissues. As the population migrates, the cells undergo differential hypertrophy. The more mitotically-active cells in the crypt that are least differentiated show greatest enlargement. The most differentiated and least mitotically-active epithelial cells show least hypertrophy. It is proposed that stem-cell hypertrophy may be an abnormal form of differentiation, which results primarily from radiation-induced mitotic inhibition. (auth)

7612

A BIOPHYSICAL STUDY OF PHAGE DNA BY MEANS OF MOLECULAR AUTORADIOGRAPHY. A. Aurisicchio, G. Cortini, and V. Emma (Univ. of Catania, Italy) and F. Graziosi (Univ. of Rome). Intern. J. Radiation Biol. **1**, 86-90(1959) Jan.

An autoradiographic technique is described for determining the molecular weight and other fundamental properties of phage desoxyribonucleic acid and similar single submicroscopic objects. (C.H.)

7613

INVESTIGATIONS ON THE EFFECT OF IONIZING RADIATIONS ON NATURAL IMMUNITY. V. L. Troitskii,

M. A. Tumanian, and A. Ia. Fridenshtein (Gamaleia Inst. of Epidemiology and Microbiology, Academy of Medical Sciences of the USSR). *J. Microbiol. Epidemiol. Immunobiol. (USSR)* (English Translation) **29**, 839-46(1958).

The course and outcome of radiation sickness are affected to a considerable extent by auto-infective processes caused either by commensal bacteria or by pathogenic bacteria in the case of latent forms of infection. Radiation bacteriemia is the result of inhibition of the body's auto-sterilization mechanism which is normally functioning in the gut wall. This mechanism is based upon the phagocytic activity of macrophages in the gut wall. (auth)

9614

EFFECT OF LONG-TERM INTERMITTENT IRRADIATION WITH SOFT X-RAYS ON THE RAT. Fuji Matsuoka (Inst. for Science of Labour). *J. Sci. Labour* **35**, 69-92(1959) Feb.

Data are summarized from a study of the pathological effects of long-term intermittent soft x irradiation on rats. (C.H.)

9615

INFLUENCE OF GAMMA-RAYS STERILIZATION UPON TEXTILES. D. R. Karba and V. Lindtner. "*J. Stefan*" *Inst. Repts. (Ljubljana)* **5**, 129-32(1958) Oct.

The textile in use for the fabrication of mattresses in hospitals was sterilized by gamma rays and by steam in order to compare the ensuing alterations. Dynamometric tests of the material were carried out in both cases. (auth)

9616

THE PATHOGENESIS OF ACUTE RADIATION SICKNESS IN THE PATHOPHYSIOLOGICAL ASPECT. P. D. Gorizontov. *Med. Radiol.* **4**, No. 1, 6-12(1959) Jan. (In Russian)

The pathogenetic action of ionizing radiation on the body is characterized by primary physicochemical and chemical changes developing due to ionization and excitation of molecules, disturbances of neuroendocrine regulatory mechanisms, and infection and manifestations of infectious and noninfectious allergy. (auth)

9617

THE EFFECT OF RADIOPHOSPHORUS ON THE CONDITIONED REFLEX ACTIVITY IN DOGS. E. A. Airikyan, O. L. Gaske, and F. N. Serkov (Pirogov Odessa Inst. of Medicine). *Med. Radiol.* **4**, No. 1, 19-26(1959) Jan. (In Russian)

Experiments were staged on four dogs with varying types of nervous activity. The method of conditioned food reflexes was used. Radiophosphorus introduced orally in therapeutic and indicator (40 to 80 mc/kg body weight) doses provokes changes in the higher nervous activity of animals. Intensification of conditioned reflexes in the day of P^{32} administration and the following inhibition of the conditioned reflex activity is the most typical action of radiophosphorus on the cerebral cortex. The depth and duration of the changes depend on the typological features of the animals. The cerebral cortex is highly sensitive to the action of internal β -irradiation. This should be considered in its therapeutic use. (auth)

9618

THE EFFECT OF SINGLE IRRADIATION OF RABBITS IN THE LAST DAYS OF PREGNANCY ON THE FUNCTIONAL CONDITIONS OF FETUSES. N. A. Kalina

(Inst. of Obstetrics and Gynecology, Academy of Medical Sciences, U.S.S.R.). *Med. Radiol.* **4**, No. 1, 26-31 (1959) Jan. (In Russian)

At the end of pregnancy (24th to 27th day) rabbits were subjected to a single total x-ray irradiation of 600 r or to irradiation of the anterior part of the body of 1200 r. The reaction of the fetuses to asphyxia caused by ligation of the umbilical cords was studied 24 and 72 hours after the irradiation: the time to the first asphyxiated inspiration, the number of respirations, and the time to the last respiratory movement (the characteristics of the condition of the respiratory centers) and the length of life. Both total irradiation and the irradiation of the anterior part of the animal body increased the excitation of the fetal respiratory centers, which was replaced by depression in 72 hours. The delay in the fetal development can be noticed by their weight in 72 hours. These data demonstrate that the changes in the condition of the maternal organism after the irradiation have an injurious effect on the fetuses (even on those which were not subjected to direct irradiation). (auth)

9619

THE EFFECT OF SINGLE X-RAY IRRADIATION ON THE GROWTH OF CEREBRAL CAPILLARIES. E. N. Kosmarskaya and Yu. I. Barashnev (Inst. of Pediatrics, Academy of Medical Sciences, U.S.S.R.). *Med. Radiol.* **4**, No. 1, 35-41(1959) Jan. (In Russian)

Experiments were performed on 31 white rats, aged from 1 to 32 days. The rats were irradiated with 250 r of x rays at different stages of development of brain capillaries. The length of life after the irradiation ranged from 5 to 6 hours to 3 months. 13 rats were irradiated at the age of 14 days (500 r); 20 rats aged from 1 to 60 days served as control. The irradiation of animals at different stages of this process provokes a delay of development followed by an active growth of cerebral capillaries. The intensified growth is replaced by a sharp decrease in the number of the developing capillaries. In irradiation of animals during the intensive development of new capillaries in the brain the growth of the capillaries is terminated 1 to 1½ months earlier than in the control white rats. Because of the effect of x rays the density of the capillary network of the brain hemispheres in irradiated animals is much less than that in the control animals. Irradiation of animals during the decline of the process of development of the new cerebral capillaries has no effect on the vasculo-capillary network of the brain hemispheres. The higher the dose of x rays the greater is the injurious effect. (auth)

9620

ACCLIMATIZATION TO HYPOXIA COMBINED WITH THE INTRODUCTION OF CYSTAMINE AND CYSTEAMINE AS A METHOD OF RADIATION SICKNESS PROPHYLAXIS. G. A. Vasiliev. *Med. Radiol.* **4**, No. 1, 41-4(1959) Jan. (In Russian)

In experiments on white mice it was shown that the action of protective substances may be influenced by the functional state of the protected body. Mice acclimatized to hypoxia were more resistant to irradiation than the non-acclimatized ones. Cysteamine and cystamine introduced to acclimatized animals prior to irradiation enhanced the protective effect. This increase of the protective effect was not more than the summation of the action of both factors. The protective action of cystamine and cysteamine apparently is not connected with

the utilization of protective mechanisms of the body. (auth)

7621

THE EFFECT OF ANTIBIOTICS ON THE INFLAMMATORY PROCESS IN IRRADIATED ANIMALS. V. F. Sosova. Med. Radiol. **4**, No. 1, 45-50(1959) Jan. (In Russian)

At the acute period of radiation sickness even a single massive dose of antibiotics may prevent the development of bacteremia and necrotic-hemorrhagic changes in places of microbe introduction, in case of an infection on the background of previously administered streptomycin or penicillin. However, in such inflammatory foci live microbes may be present for a long time. Numerous (for 5 days) intramuscular introduction of streptomycin almost completely destroys the microbes in inflammatory foci infected in 15 minutes following the first injection of the antibiotic. In intramuscular administration of streptomycin to irradiated and non-irradiated rabbits, the drop of the concentration of the antibiotic in the blood was in dependence to the dose introduced. (auth)

7622

THE INFLUENCE OF X-RAY IRRADIATION ON CHRONIC FOCUS OF AUTOINFECTION. V. G. Avetkian and A. G. Artemova (Inst. of Experimental Medicine, Academy of Medical Sciences, U.S.S.R.). Med. Radiol. **4**, No. 1, 50-3(1959) Jan. (In Russian)

On the basis of experiments conducted on mice with an experimentally induced focus of autoinfection (effected by ligation of a portion of the cecum), it was concluded that in instances when the autoinfection focus is limited by barriers and the infectious process becomes chronic, the ionizing irradiation is unable to provoke the development and generalization of the infection. (auth)

7623

CONTENTS OF LIPIDS IN THE MICROSTRUCTURES OF THE LIVER CELLS IN RABBITS IN ACUTE RADIATION SICKNESS. V. D. Blokhina. Med. Radiol. **4**, No. 1, 53-9(1959) Jan. (In Russian)

The contents of common lipids and phospholipids were studied in mitochondrias, microsomas of liver cells, on the 1, 3, 5, and 6th day after 1000-r x-ray irradiation. Small increase in the contents of common lipids and mitochondria was established, as well as more pronounced increase of common lipids in microsomas of the liver cells in rabbits 24 hours after irradiation. At the same time the content of phospholipids in the cytoplasmic microstructures of the liver cells did not undergo extensive changes in a given species of animals. (auth)

7624

ABSENCE OF SUMMATION OF PROTECTIVE EFFECT OF CYSTEINE AND ACTH IN IRRADIATION OF RATS BY X-RAY. E. M. Kedrova and M. A. Krekhova. Med. Radiol. **4**, No. 1, 60-3(1959) Jan. (In Russian)

The protective effect of various doses of cysteine and ACTH as well as the combined action of both preparations was studied. Experiments were carried out on rats, irradiated by x ray doses of 600 to 700 r. As a result of experimental work it was established that introduction of ACTH 1 unit per day for 3 to 7 days previous to irradiation decreases the death rate of irradiated animals. The most pronounced effect was obtained by introducing the hormone for 6 days. Large doses of

ACTH or its prolonged administration decreased its positive effect. The introduction of protective dose of ACTH was ineffective when cysteine was given before irradiation in doses which had a protective effect on animals not treated by ACTH beforehand. On the contrary, combined treatment of rats by ACTH and cysteine accelerated the death of the animals. (auth)

7625

THE PROPHYLAXIS OF RADIATION SICKNESS. V. V. Antipov and I. G. Krasnykh. Med. Radiol. **4**, No. 1, 63-5(1959) Jan. (In Russian)

Experiments were performed on 392 mice to assess the protective effects of para-aminopropiophenone and its formaldehydebisulfate derivative and para-aminobutero-phenone against x irradiation. The preparations were introduced into the esophagus one to three hours prior to irradiation. The first two agents were administered in a 20% ethyl alcohol solution, the third in 0.5% aqueous solution. The doses were 50 to 100 mg/kg body weight. The animals were irradiated with the dose of 900 r. The investigations revealed that the largest protective effect is possessed by paraaminopropiophenone and its formaldehydebisulfate derivative in the dose of 50 mg/kg body weight, introduced one hour before irradiation. 20 to 25% of mice survived in this method of administration. (auth)

7626

EFFECTS OF POLYPHOSPHATES ON DISTRIBUTION OF Ce^{144} . Yu. I. Moscalev. Med. Radiol. **4**, No. 1, 65-72(1959) Jan. (In Russian)

The intravenous injection of hexametaphosphate immediately after exposure reduced the Ce^{144} content in liver from 38.7 to 5.4% and in the skeleton from 14.4 to 7.2%. Excretion with the urine and the feces was sharply increased. The effects of the hexametaphosphate are proportional to the dose applied. The optimum dose is 100 to 200 mg per rat. Applications of the hexametaphosphate 6 hours or 1 to 2 days after exposure did not reduce the Ce^{144} content in the organs. Intravenous injection of Kurrol's and Maddrell's salts reduce the Ce^{144} content 1.5 times in comparison to the control rats. (R.V.J.)

7627

TREATMENT OF DYSENTERY IN EXPERIMENTAL RADIATION SICKNESS. E. A. Brodskaya, V. P. Emaikina, and A. G. Kostritsa. Med. Radiol. **4**, No. 1, 82(1959) Jan. (In Russian)

Experiments with 53 cats (one group exposed to 275 r and the other to 800 r and infected with the Flexner dysentery) showed that the exposure to 275 r did not change the general condition of the cats while the 800 r resulted in a sharp rise of temperature, diarrhea, heavy dystrophic-necrotic changes in the intestines, and peculiar mucous and submucous processes. (R.V.J.)

7628

INFLUENCE OF LOW BAROMETRIC PRESSURE ON THE COURSE OF INFLUENZA IN IRRADIATED MICE. V. P. Emaikina and O. P. Lebedeva. Med. Radiol. **4**, No. 1, 83-5(1959) Jan. (In Russian)

Observations of mice exposed to 400 r and placed into a barometric chamber with simulated conditions of 5000 in elevation, and infected with APR₁ influenza 9 days after exposure, showed a lowered resistance to the infection. Fatality was greater than 50% after 8 to 11 days. (R.V.J.)

9629

INVESTIGATION WITH THE HELP OF RADIOACTIVE TRACERS ON THE LOSS OF TRACE ELEMENTS IN THE DESTRUCTION OF BIOLOGICAL MATERIAL. J. Pijck, J. Hosté, and J. Gillis. Mededel. Koninkl. Vlaam. Acad. Wetenschap. Belg. Kl. Wetenschap. 20, No. 8, 3-19(1958). (In Dutch)

After a brief description of the destruction mechanism as reported in the literature, two experimental destruction methods were studied with the help of radioactive tracers. On the basis of the results, it appears the destruction by the dry method leads to considerable loss of the trace elements even at relatively low destruction temperature. The destruction by the wet method with the mixture $\text{HNO}_3\text{--HClO}_4\text{--H}_2\text{SO}_4$ permits, in most cases, the quantitative determination of the trace elements. A loss was avoided by the use of an efficient backflow cooler in the case of Fe, As, Sb, Au, and Hg. (tr-auth)

9630

FUNDAMENTALS AND PROBLEMS OF RADIO-COLLOID THERAPY. E. H. Graul (Phillips-Univ. of Marburg/Lahn, Ger.). Medicamundi 4, 37-56(1958).

The metabolic behavior of radiocolloidal substances is reviewed. The effects on uptake of the manner of application, the size of the particles, and their relation to the pH of the body fluids are discussed. The stability of the radiocolloidal solution can be increased by the addition of protective colloids. Factors are discussed which ensure the most favorable distribution in the body of specific colloidal substances of therapeutic interest. (C.H.)

9631

DIFFERENTIAL DISTRIBUTION OF RADIOACTIVE STRONTIUM AND YTTRIUM IN THE TISSUES OF THE RABBIT'S EYE. R. H. Mole (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.); Antoinette Pirie (Univ. of Oxford); and Janet M. Vaughan (Churchill Hospital, Oxford). Nature 183, 802-7(1959) Mar. 21.

Weanling rabbits were injected intravenously with an equilibrium mixture of strontium-90 and yttrium-90 or with yttrium-91 in doses of between 72 and 600 $\mu\text{C}/\text{kg}$ body-weight and killed at various intervals of time thereafter. Some of the animals were given a daily dose of strontium-90 by mouth. Investigations were to determine the concentration of the isotopes in different tissues of the eyes. All parts of the rabbit's eye, except the lens, accumulated strontium-90 to a greater degree than striated muscle, a representative soft tissue. The pigmented parts accumulated most, the iris having 0.5 per cent of the concentration in the femur at 9 to 30 days when redistribution was approaching completion. There were much bigger differences between physiologically different parts of the eye in their retention of strontium-90. Yttrium-90 and strontium-90 were rarely in equilibrium in any part of the eye at any time after administration of an equilibrium mixture. The retina maintained the largest excess of yttrium-90, although its direct uptake of yttrium-91 was small. (J.H.M.)

9632

PROTECTIVE EFFECT OF β -AMINOETHYLTHIO-SULPHURIC ACID AGAINST IONIZING RADIATION. Bo Holmberg and Bo Sörbo (Research Inst. of National Defence, Sundbyberg, Sweden). Nature 183, 832(1959) Mar. 21.

The protective effect of β -aminoethylthiosulfuric acid on mice irradiated with a lethal dose of x rays, as compared with that of cysteamine hydrochloride, is reported. Results indicate that β -aminoethylthiosulfuric acid increases both the time and rate of survival, although the latter showed a smaller increase than in mice injected with cysteamine. (J.H.M.)

9633

LEUCOCYTOSIS IN RESPONSE TO BACTERAEMIA AS A FEATURE OF THE ACUTE RADIATION SYNDROME IN THE PLAICE. A. Preston (Ministry of Agriculture, Fisheries Radiobiological Lab., Lowestoft, Eng.). Nature 183, 832-3(1959) Mar. 21.

Bacteremia associated with leukocytosis was observed in plaice following exposure to 8,000 r x radiation. These fish died 45 and 51 days after exposure. Hematological values are tabulated for blood removed within a few minutes of death. A feature of the acute radiation syndrome in cold-blooded vertebrates is the extended period between exposure and the onset of symptoms. (C.H.)

9634

THE HEMATOLOGICAL CHANGES IN ANIMALS WITH ACUTE RADIATION SICKNESS CAUSED BY RADIATION FROM THE BETATRON. G. P. Garganev (Dept. of Pathological Physiology, Tomsk Medical Inst.). Problems Hematol. Blood Transfusion (USSR) (English Translation) 3, 277-83(1958).

Results are presented from observations on cases of acute radiation sickness developing after the irradiation of guinea pigs with various doses of electromagnetic radiation from a betatron beam. As a result of irradiation the guinea pigs developed the typical picture of radiation sickness with characteristic hematological changes. The findings are summarized. (C.H.)

9635

THE ACTION OF VITAMIN B_{12} ON THE BLOOD OF NORMAL AND IRRADIATED ANIMALS. G. D. Berdyshev (Departments of Biology and of Pathological Physiology, Tomsk Medical Inst.). Problems Hematol. Blood Transfusion (USSR) (English Translation) 3, 284-9(1958).

A study was made of the protective effects of vitamin B_{12} against radiation injuries in mice and guinea pigs. No evidence was found of a beneficial action on hemopoiesis in animals exposed to moderate doses of x radiation. (C.H.)

9636

ANTI-LEUCOCYTE ANTIBODIES IN HYPOPLASTIC ANAEMIA AND CHRONIC RADIATION SICKNESS. A. A. Bagdasarov, K. M. Dvolaitskaja-Barysheva, F. I. Bolotnikova, M. P. Bogoiavlenskaja, and F. E. Fainshtein (Central Inst. of Hematology and Blood Transfusion, Ministry of Health of the USSR). Problems of Hematol. Blood Transfusion (USSR) (English Translation) 3, 217-22(1958).

Antibodies against leukocytes were discovered by the agglutination method in the sera of patients with chronic and partial hypoplastic anemia, chronic radiation sickness, and hemolytic anemia. Agglutinins to leukocytes were not found in the sera of healthy persons. Repeated investigations of the serum showed the persistent presence of leuco-agglutinins, especially in patients with partial hypoplastic anemia. Under the influence of cortisone and ACTH therapy a fall in the leuco-agglutinin titer was observed. (auth)

7637

THE MUTATION RATE IN DROSOPHILA AFTER HIGH DOSES OF GAMMA RADIATION. P. T. Ives (Amherst Coll., Mass.). Proc. Natl. Acad. Sci. U.S. 45, 188-92(1959) Feb.

Data are presented from a study of the sex-linked mutation rate in mature sperm of *D. melanogaster* at seven dosage levels of cobalt-60 γ radiation in the 300 r to 12.5 kr range. Lethal chromosomes from the lowest and highest doses were analyzed genetically, and the results are compatible with the interpretation that a Poisson-like accumulation of lethal mutations occurred throughout this dosage range, with an average increase of 2 per cent lethal mutations per kr. (auth)

7638

BONE DOSES FROM STRONTIUM-90. W. F. Libby (Carnegie Institution of Washington and U. S. Atomic Energy Commission, Washington). Proc. Natl. Acad. Sci. U. S. 45, 245-9(1959) Feb.

For condensed systems beta radiation is exponentially absorbed with an absorption coefficient, μ , given by: $\mu = (1 + M/100)/1.27 \times 55E^{1/2}$, where μ is given in units of cm^2/mg , E is the maximum energy of the beta spectrum in millions of electron volts, and M is the average atomic weight of the absorbing medium. This relation is applied to radiation-dose calculations for strontium-90 in equilibrium with its daughter, yttrium-90, deposited in bone. (C.H.)

7639

EFFECT OF WHOLE BODY X-IRRADIATION ON PLASMA IRON TURNOVER IN RATS. Eb C. Girvin and John K. Hampton, Jr. (Tulane Univ., New Orleans). Proc. Soc. Exptl. Biol. Med. 100, 481-3(1959) Mar.

The depression of plasma radioiron turnover rates in rats following x irradiation was studied. The depression is prompt (maximal by 24 to 30 hours) and, at 24 hours post-irradiation, is directly related to dose between 50 and 300 r. Recovery occurs by the 6th post irradiation day, indicating that subsequent anemia is more likely due to hemorrhagic diathesis than bone marrow dysfunction. Sensitivity of the radioiron turnover method permitted a study of bone marrow response at frequent short intervals after irradiation. (auth)

7640

ACQUIRED RADIORESISTANCE. A REVIEW OF THE LITERATURE AND REPORT OF A CONFIRMATORY EXPERIMENT. Michael P. Dacquist (Walter Reed Army Medical Center, Washington). Radiation Research 10, 118-29(1959) Feb.

The ability of experimental animals to develop significant radioresistance by prior exposure to small doses of x radiation seems to be well established. An experiment is reported which shows that for control adult female white Swiss mice, Walter Reed strain, the $LD_{50(30)}$ is 487 ± 25.7 r. If they are given 50 r WBR 10 days prior, it increases to $560 \text{ r} \pm 31.0$ r; and if the interval is 17 days, it is $617 \text{ r} \pm 32.0$ r. In this experiment radioresistance was manifest at both 10 and 17 days after the small exposure. Analysis of spleen and thymus weights under the conditions of these experiments gave no clue to the mechanism of the acquired radioresistance. Alternate hypotheses have been suggested, but the phenomenon remains unexplained. (auth)

7641

METABOLISM OF Pu^{239} IN ADULT BEAGLE DOGS.

Betsy J. Stover, D. R. Atherton, and N. Keller (Univ. of Utah, Salt Lake City). Radiation Research 10, 130-47(1959) Feb.

The metabolism of plutonium in young adult beagle dogs was studied over a period of 4 years after a single intravenous injection of Pu(IV) in citrate buffer of pH 3.5. Three time periods were arbitrarily chosen to facilitate treatment of the plasma concentration and excretion rate data. For times greater than 3 weeks after injection, the per cent retention calculated from excretion measurement is $R = 90.0 - 0.434t^{0.515}$ when t is in days. The major part of the plutonium deposits in the skeleton and the liver, and the results of tissue measurements agree well with the retention calculated from excretion. No effect of dose level, age at injection, or sex could be demonstrated in the excretion studies. Comparison of the results with those of some early studies in which mongrel dogs were given much larger doses showed remarkable similarities. Plutonium metabolism in the dog is more like that in man than in rat. The liver deposition persists for long times in man and dog, but not in the rat. The retention in man is a little higher than in beagles, but the distributions are quite similar. The average dose rates and average cumulative doses to the skeleton and to the liver of the beagles are about equal (when calculated on the basis of uniform distribution). Skeletal damage greatly predominates, however. A limited preliminary comparison of skeletal effects of Pu^{239} and Ra^{226} on the basis of the amount of energy dissipated in bone shows that plutonium is more toxic. (auth)

7642

THE EFFECT OF X-IRRADIATION ON THE ANTI-OXIDANT ACTIVITY OF MAMMALIAN TISSUES. Albert A. Barber and Karl M. Wilbur (Duke Univ., Durham, N. C.). Radiation Research 10, 167-75(1959) Feb.

Tissue antioxidant activity was measured by the capacity of tissue supernatants to inhibit peroxide formation when added to rat liver homogenate. Blood, ascitic fluid, intestinal mucosa, and bone marrow had the highest antioxidant activity. Testis and spleen had less, and liver and brain had none. Peroxide formation in this test system was inhibited by citrate and EDTA. FeCl_3 and low concentrations of ascorbic acid were catalytic. Whole-body irradiation destroyed the antioxidant activity of the mucosa but had no effect on that of other tissues. The mucosa from irradiated animals catalyzed peroxide formation in incubated methyl linolenate emulsions as well as in the liver homogenate. When tested by the inhibition of melanin formation, the antioxidant activity of irradiated mucosa was somewhat less than that of the unirradiated controls, but it never catalyzed this reaction. (auth)

7643

RELATIVE BIOLOGICAL EFFECT OF FISSION NEUTRONS WITH THE BROAD BEAN ROOT (VICIA FABA) AS A TEST SYSTEM. J. F. Spalding, V. G. Strang, and J. A. Sayeg (Los Alamos Scientific Lab., N. Mex.). Radiation Research 10, 176-9(1959) Feb.

Lethality of the broad bean root was used as a test system to obtain the RBE for fission neutrons. The LD_{50} dose for fission neutrons was 46.4 ± 3.8 rads; comparison to the γ -ray LD_{50} of 345.6 ± 21.4 rads gave an RBE of 7.4 ± 0.8 . (auth)

7644

MICROSCOPIC METABOLISM OF CALCIUM IN BONE. I. THREE-DIMENSIONAL DEPOSITION OF

Ca⁴⁵ CANINE OSTEONS. J. H. Marshall (Argonne National Lab., Lemont, Ill.); V. K. White (Massachusetts Inst. of Tech., Cambridge); and J. Cohen (Children's Medical Center, Boston). Radiation Research 10, 197-212(1959) Feb.

From data obtained from two adult dogs, one young, the other middle-aged, regions of Ca⁴⁵ uptake in canine osteons were found to have a wide distribution of lengths parallel to the axis of a long bone which averaged about 2 mm. This distribution and average length correspond well to the lengths of canine resorption cavities found histologically. The most active regions of Ca⁴⁵ uptake had lengths of the order of a millimeter. No consistent correlation was found between the locations of vascular connections to osteons and the limits of the regions of Ca⁴⁵ deposition. The deposits of Ca⁴⁵ in osteons can be explained qualitatively in terms of the formation of new bone in locations governed primarily by the locations of previous resorption tunneling. It should be possible to find many osteons in dog in which the distribution of Ca⁴⁵ is approximately invariant in the longitudinal direction within distances of the order of 10⁻² cm. (auth)

9645

MICROSCOPIC METABOLISM OF CALCIUM IN BONE. II. QUANTITATIVE AUTORADIOGRAPHY. J. H. Marshall, R. E. Rowland, and J. Jowsey (Argonne National Lab., Lemont, Ill.). Radiation Research 10, 213-33(1959) Feb.

A quantitative autoradiographic technique was developed for evaluating the β -particle activity in radioactive sources in which the distribution of activity is invariant in at least one dimension for a distance of more than 5 to 10% of the maximum particle range. The method is applicable to any β -emitter or mixture of β -emitters and to any autoradiographic film because it depends on symmetry arguments rather than on calculation of β -particle absorption and scattering. (auth)

9646

MICROSCOPIC METABOLISM OF CALCIUM IN BONE. III. MICRORADIOGRAPHIC MEASUREMENTS OF MINERAL DENSITY. R. E. Rowland, J. Jowsey, and J. H. Marshall (Argonne National Lab., Lemont, Ill.). Radiation Research 10, 234-42(1959) Feb.

The range of microscopic calcium densities in man and in dog does not change with the age of the individual. The ranges, however, are not the same in the two species. New bone mineral in the dog is formed at higher density than similar mineral in man, and highly mineralized bone in the dog is more dense than the most dense bone in man. Thus species differences in calcium metabolism of bone do exist and should not be overlooked in the intercomparison of the uptake and retention of the alkaline earths in mammalian skeletons. (auth)

9647

MICROSCOPIC METABOLISM OF CALCIUM IN BONE. IV. Ca⁴⁵ DEPOSITION AND GROWTH RATE IN CANINE OSTEONS. J. H. Marshall, J. Jowsey, and R. E. Rowland (Argonne National Lab., Lemont, Ill.). Radiation Research 10, 243-57(1959) Feb.

The Ca⁴⁵ content of individual osteons in three dogs given single intravenous injections has been measured autoradiographically and correlated with osteon canal diameter measured from microradiographs. An osteon was found to contain up to 10⁻⁶ of the injected

activity, its total activity per unit length being approximately proportional to the square of its canal diameter at the time of injection. The activities observed at 12 hours or 2 weeks after injection divided by the corresponding time integral of the blood specific activity yield an accretion rate for calcium at each canal diameter such that the half-diameter time for the canal of an average forming osteon in a rather wide distribution is 3 ± 1 weeks, which is consistent with direct observations of osteon growth. It is concluded that the intense concentrations of *in vivo*-deposited Ca⁴⁵ which we have observed in canine osteons 12 hours or more after injection are due to accretion of calcium in appositional growth at approximately the specific activity measured in the large veins. The nature of the Ca⁴⁵ uptake in osteons which have completed or arrested appositional growth before injection cannot be inferred from the present data, but such uptake is here of an order of magnitude less than that due to appositional growth. Comparison of calculated blood flow with observed osteon growth rate indicates that an osteon in the early stages of appositional growth accretes a large fraction of the calcium reaching it by its capillary. The total rates of accretion and resorption due to osteon formation, the shapes of osteon hotspot distributions, the specific activity in a capillary, and hotspot migration are discussed. (auth)

9648

MICROSCOPIC METABOLISM OF CALCIUM IN BONE. V. THE PARADOX OF DIFFUSE ACTIVITY AND LONG-TERM EXCHANGE. J. H. Marshall, R. E. Rowland, and J. Jowsey (Argonne National Lab., Lemont, Ill.). Radiation Research 10, 258-70(1959) Feb.

By quantitative autoradiography and quantitative microradiography the *in vivo* diffuse uptake of Ca⁴⁵ in highly mineralized canine bone many years old has been measured and identified primarily with long-term exchange of calcium. By long-term exchange we mean an equal rate of transfer of calcium atoms in opposite directions between blood and bone in which the mean residence time of an individual calcium atom in bone is long, here of the order of a month or longer. In microscopic regions of canine cortical bone with a calcium density of 0.60 ± 0.03 gm_{Ca}/cm³, the rate of transfer of calcium atoms between blood and bone in this exchange is 0.05 to 0.20 gm_{Ca} per year per gram of calcium in bone. This rate of calcium transfer represents a significant fraction of the total calcium turnover in the skeleton of an adult dog and may play an important part in the calcium regulation of the blood. The possible implications for the distribution of long-term radiation dose to the skeleton due to internally deposited Sr⁹⁰ or Ra²²⁶ are being examined. The observed rate of calcium transfer suggests that loss of Ca⁴⁵ activity from highly mineralized canine bone by a process other than resorption should be just detectable over a period of a year. (auth)

9649

THE RELATIONSHIP BETWEEN DIVISION AND X-RAY SENSITIVITY, ULTRAVIOLET SENSITIVITY, AND PHOTOREACTIVATION IN YEAST. M. M. Elkind and Harriet Sutton (National Cancer Inst., Bethesda, Md.). Radiation Research 10, 283-95(1959) Mar.

Results are summarized from a series of experiments on the relationship between division and x-ray sensitivity, ultraviolet sensitivity, and photoreactiva-

tion in yeast. Data are presented graphically, and results are discussed. (C.H.)

9650

SITES OF ACTION OF LETHAL IRRADIATION: OVERLAP IN SITES FOR X-RAY, ULTRAVIOLET, PHOTO-REACTIVATION, AND ULTRAVIOLET PROTECTION AND REACTIVATION IN DIVIDING YEAST CELLS.

M. M. Elkind and Harriet Sutton (National Cancer Inst., Bethesda, Md.). Radiation Research 10, 296-312(1959) Mar.

Data are presented from which it is concluded that in dividing yeast cells, irrespective of their ploidy, the competence of their respiratory systems, and their sensitivity to visible light, there is considerable overlap in sites sensitive to x rays, ultraviolet light, visible light reversal of ultraviolet lethality, and ultraviolet reactivation of, or protection against, x-ray lethality. Data are presented graphically, and results are discussed. (C.H.)

9651

LONG-TERM EFFECTS OF WHOLE-BODY IRRADIATION ON LYMPHOCYTE HOMEOSTASIS IN THE MOUSE. D. Metcalf (Children's Medical Center, Boston). Radiation Research 10, 313-22(1959) Mar.

After whole-body irradiation with 250 or 350 r, a persistent lymphocytosis develops in C₅₇Bl mice, subsequent to the initial lymphopenia. Serum assays of irradiated mice showing this lymphocytosis reveal elevated levels of the thymic lymphocytosis stimulating factor (LSF). Irradiated mice do not develop a lymphocytosis in response to either trauma or the injection of LSF. Thymectomy, either before or after irradiation, allows normal responsiveness of irradiated mice to LSF. (auth)

9652

RADIUM IN HUMAN BONE: THE MICRORADIOGRAPHIC APPEARANCE. R. E. Rowland, J. H. Marshall, and J. Jowsey (Argonne National Lab., Lemont, Ill.). Radiation Research 10, 323-34(1959) Mar.

Changes occur in the mineral components of human bone when it contains Ra²²⁶. These changes are not necessarily found in the regions of high concentration of radioactivity. The uniformity with which these microradiographic abnormalities are seen throughout cortical bone suggests that these lesions are probably only symptomatic of the primary radiation damage. (auth)

9653

PROTECTION OF THE IRRADIATED GROUND SQUIRREL BY CYSTEINE. Douglas E. Smith (Argonne National Lab., Lemont, Ill.). Radiation Research 10, 335-8(1959) Mar.

Intravenous injection of cysteine prior to irradiation significantly protects the nonhibernating ground squirrel from the lethal effects of x rays. Such protection was not demonstrated when cysteine was administered to the hibernating ground squirrel after irradiation. Some ground squirrels irradiated while hibernating spontaneously awake from hibernation for short periods of time. The significance of these findings and their relation to previous work are discussed. (auth)

9654

LESIONS OF THE TONGUE IN IRRADIATED MICE. O. Vos, F. Wensinck, and D. W. Van Bekkum (Medical Biological Lab. of the National Defence Research Council TNO, Rijswijk, The Netherlands). Radiation Research 10, 339-46(1959) Mar.

Postmortem examination of nearly 700 CBA and C57BL mice that died after total-body exposure to 675 and 750 r revealed macroscopic lesions of the tongue in 23% of the cases. Microscopic lesions were found to be much more frequent. The lesions resemble an abscess or an ulcer and consist of a heavily infected necrotic mass. Cellular reaction is absent. The possibility that the lesions are the portal of entry for microorganisms in the development of the bacteremia associated with the bone marrow syndrome is discussed. (auth)

9655

THE EFFECTS OF SINGLE AND DIVIDED DOSES OF X-RADIATION ON BONE MARROW OF PARTIALLY SHIELDED RATS. Raymond G. Murray (Indiana Univ., Bloomington). Radiation Research 10, 347-56(1959) Mar.

A total of 48 rats was exposed in a variety of ways to 200-kvp x rays. Bone marrow in an exposed lower quadrant which received 900 r in five daily fractions of 180 r while the remaining three-fourths of the rat was shielded showed less recovery at 10 to 12 days than marrow which received 525 r of total-body irradiation in a single dose. The fact that partial shielding and dividing the dose did not give more protection suggests that these two protective mechanisms are not additive. Mild irradiation appeared to produce slight but measurable resistance to a heavy dose of x ray at 3 days or 10 days after the mild treatment. Plasma cells were undamaged by 525 r or 5 × 180 r and increased significantly in the marrow 5 and 10 days after irradiation by transformations from hemocytoblasts, and possibly from early erythroblasts and myelocytes. (auth)

9656

PAPER ELECTROPHORETIC ANALYSES OF SERA FROM IRRADIATED RHESUS MONKEYS. Charles A. Leone, Anne Rimkus Hartnett, Robert Crist, and Carolee McBeth (Argonne National Lab., Lemont, Ill. and Univ. of Kansas, Lawrence). Radiation Research 10, 357-69(1959) Mar.

Periodic preirradiation and postirradiation samples of sera from 23 monkeys were studied by means of paper-strip electrophoresis. The changes in concentration of the total proteins, the albumins, the α -globulins, the β -globulins, and the γ -globulins were followed. Eleven TB+ animals received 60 r of Co⁶⁰ γ rays every 2 weeks until they died; 5 TB+ animals received 100 r of γ rays every week until they died; 7 TB- animals received 600 r of x rays in a single exposure; 1 TB+ animal was not irradiated. In 20 of the 23 irradiated monkeys there was a decrease in serum albumin. In all irradiated monkeys there was an increase in α -globulin. All proteins of the sera fluctuated considerably in their absolute concentration. The β - and γ -globulins appear to be complementary with respect to one another. (auth)

9657

RADIATION DESTRUCTION OF THE PLAQUE-FORMING ABILITY OF SPORES OF LYSOGENIC BACILLUS MEGATERIUM. Carl Woese (Yale Univ., New Haven). Radiation Research 10, 370-9(1959) Mar.

The destruction by x rays of the plaque-forming ability of three phages and spores of *Bacillus megaterium* strains lysogenic for these phages is studied. It is found that the phages inactivate in a single-target fashion, whereas the spores inactivate in a two-target fashion as a function of x-ray dose. There is in every case a constant ratio between radiation size of the free

phage and radiation size of the corresponding plaque-forming ability of the lysogenic spore. These results are interpreted to mean that the plaque-forming ability of the spore is destroyed by destroying the prophage, that there are two prophages per spore, and that for noninducible lysogenic strains the prophage is not an addition to already existing bacterial genetic material, but results from the replacement of existing bacterial genetic by, or its transformation into, phage genetic material. (auth)

9658

FURTHER OBSERVATIONS ON THE EFFECT OF X-IRRADIATION ON THE GLYCOGEN CONTENT AND HISTOLOGY OF THE RABBIT RETINA. Sidney P. Kent (Univ. of Alabama Medical Center, Birmingham). *Radiation Research* 10, 380-5(1959) Mar.

The heads of groups of New Zealand white male rabbits were exposed to 3000 r, 4000 r, 5000 r, 6000 r, 7000 r, and 10,000 r of x irradiation. Another group of rabbits received 6000 r of head irradiation with one eye shielded by lead. The morphological changes and glycogen content were studied. Glycogen accumulated in the outer nuclear layer of the retina in all irradiated groups except the 3000-r group. This accumulation was associated with morphological changes suggestive of cell death. Shielding one eye with lead completely protected that eye from these changes. The relation of this glycogen accumulation to the accumulation of liver glycogen after whole-body irradiation was discussed. (auth)

9659

INFLUENCE OF CALCIUM ON PLANT UPTAKE OF Sr-90 AND STABLE STRONTIUM. E. M. Romney, C. V. Alexander, W. A. Rhoads, and K. H. Larson (Univ. of California, Los Angeles). *Soil Sci.* 87, 160-5 (1959) Mar.

The effects of applied Ca on uptake of Sr^{90} by beans from nutrient solutions independent of soil factors was studied. In general Ca inhibited Sr uptake when applied in amounts equivalent to 2 to 5 t/acre. (T.R.H.)

9660

THE QUALITY OF THE LEUKOCYTE RESISTANCE VALUE IN THE RAT AFTER INTRACAVITARY INJECTION OF Au^{198} . Werner Dietz, Klaus Damminger, and Manfred Haering (Universitäts-Frauenklinik, Freiburg i. B. and Philipps-Universität, Marburg, Ger.). *Strahlentherapie* 108, 219-30(1959) Feb. (In German)

The resistance rate of white blood cells against mechanical pressure differences (ultra sound) is a biological value of the blood for functional diagnosis of the generation of white blood cells. The test is simple and quick to perform. After intraperitoneal and intrapleural application of radio gold (studies on white rats) the rate changes according to the dose. The reaction is different depending on the localization of the application. Conclusions are presented on the origin of an illness syndrome after application of radioactive substances at different localizations. Studies of comparison demonstrate the importance of absolute rest after the application of radioactive isotopes for the overcoming of the radiation insult. The experiments were completed by histological studies. (auth)

9661

INVESTIGATION OF THE ADRENAL CORTEX FUNCTION IN WHOLE BODY IRRADIATION AFTER APPLICATION OF PERISTON-N. Eberhard Löhr (Max-

Planck-Institut für Biophysik, Frankfurt am Main). *Strahlentherapie* 108, 231-8(1959) Feb. (In German)

In mice and rats the excretion of 17-ketosteroids and 17-ketogens was used as a test of the function of the adrenal cortex. After whole-body irradiation of 1,000 r the animals died within 3 to 4 days. A primary increase of the 17-ketosteroids was observed in almost every animal within 24 hours after irradiation. Administration of Periston-N after irradiation has no significant effect on the survival time, but a decrease of the excretion of 17-ketosteroids within 24 hours was observed. The additional administration of theophylline has no effect on survival time and excretion of the hormones. After injection of urine of irradiated rats an increase of the excretion of ketogens was observed. No real radiation sickness occurred in animals after the injection of urine of irradiated animals treated with Periston-N, which is in contrast to previous observations. All animals survived a 30-day period. An antitoxic effect and effects for radiation protection of Periston-N could not be observed but an effect on the course of the radiation sickness is presumable. (auth)

9662

TEST DOSES AND RADIATION DAMAGE IN LOCALIZATION INVESTIGATIONS WITH GAMMA EMITTING ISOTOPES. Dietrich Frost (Städt. Rudolf-Virchow-Krankenhaus, Berlin). *Strahlentherapie* 108, 239-50 (1959) Feb. (In German)

The minimum amount of an isotope required for localization tests by means of gamma emitting isotopes were determined theoretically. The calculation was done taking the thyroid gland as an example. The test dose necessary to obtain a diagnostic scintigram or gammagram was determined for four different types of scanning devices. The radiation exposure of the thyroid gland and total-body radiation by these test doses were also reported. (auth)

9663

INVESTIGATIONS ON A BIOLOGICAL RADIATION PROTECTOR. XXX. THE RADIATION PROTECTION EFFECT OF 5-HYDROXYTRYPTAMINE IN ANIMAL RESEARCH. Hanns Langendorff, Hans-Joachim Melching, and Hans-Adolf Ladner (Univ. of Freiburg i. B.). *Strahlentherapie* 108, 251-6(1959) Feb. (In German)

In a series of studies concerning the mode of action of reserpine for radiation protection of animals, the effect of 5-hydroxytryptamine was reported. The prophylactic treatment of mice with 5-hydroxytryptamine has a good effect for radiation protection. The effect is more marked than it was in all other previously tested substances. (auth)

9664

THE BEHAVIOR OF BISMUTH-206 COMPLEXES IN EXPERIMENTAL LEUKEMIA OF THE MOUSE. I. Ferdinando Passalacqua (Univ. of Freiburg i. B. and Heiligenberg-Institut, Heiligenberg/Baden, Ger.). *Strahlentherapie* 108, 257-61(1959) Feb. (In German)

The behavior of leukemic mice was compared with control animals after the administration of bismuth-(Bi^{206})-camphorcarbonatleicithin. The activity per mg of organ weight (spleen, liver, kidney, lung) was very similar in both series. However, the total concentration of bismuth-camphorcarbonatleicithin in the leucemic spleen (average organ weight 1777.66 ± 201.00 mg) was 18 times higher than it was in the spleen of control animals with an average organ

weight of 95.75 ± 31.00 mg. Since Bi^{206} is a gamma emitter, this fact could be of some therapeutic importance. (auth)

9665

COMPARISON OF SOME SULFHYDRYL COMPOUNDS IN RADIATION PROTECTION ACCORDING TO DEGREE OF EFFECT AND TIME DEPENDENCE. Walter Braun, Ernst-Josef Kirnberger, Günther Stille, and Viktor Wolf (Laboratorien der Nordmark-Werke G.m.b.H., Hamburg). Strahlentherapie 108, 262-8 (1959) Feb. (In German)

The toxic and therapeutic doses for radiation protection of several chemical compounds were compared by the survival test of the white mouse. All compounds showed a very low therapeutic index. Of the substances tested β -aminoethylisothiuroniumchloride hydrochloride was superior to the other compounds in oral administration. Generally the effect of radiation protection was of short duration. However, using HCT and AHCT the effect lasted more than 3 hours but was low. The delayed effect of radiation protection was explained by slow release of SH-radicals from the lactone-ring as it was described by Koch and Schwarze, and by the authors. Resorption from the intestinal tract in oral administration also plays an important part as it can be demonstrated by the different onset of action after oral and parenteral administration of AHCT. (auth)

9666

EXPERIMENTAL INVESTIGATIONS ON THE EFFECT OF CORTISONE DERIVATIVES IN RADIATION PRODUCED LARYNX EDEMA. Peter Krahl and Erwin Maier (Universitäts-Hals-Nasen-Ohren-Klinik, Heidelberg, Ger.). Strahlentherapie 108, 269-75 (1959) Feb. (In German)

Twenty rabbits were used for experiments on radiation induced edema of the larynx. The radiation reaction was produced by a single deep therapy treatment of the larynx from 2 lateral ports of 8000 r. Ten to 14 days later dyspnea and stridor developed due to acute inflammatory and edematous swelling of the soft tissues inside the larynx. The respiration rate was taken to judge the degree of dyspnea. The respiration rate of normal rabbits is about 140 per minute. After irradiation it had dropped below 80 per minute. After onset of the dyspnea and decrease of the respiration rate below 80 per minute, daily intramuscular injections of 12.5 mg of Prednisolone were started. Within a few days the condition of 14 animals had considerably improved and dyspnea and stridor disappeared. Six animals did not improve, and 4 untreated animals had to be killed after a few days because their dyspnea steadily increased. Based on these experiments we could recommend the clinical use of cortisone derivatives in similar cases. (auth)

9667

THE RESULTS OF THYROID INVESTIGATIONS WITH RADIOIODINE IN A BIPHASE STUDY. Konrad Hennig (Medizinischen Akademie, Dresden). Strahlentherapie 108, 288-92 (1959) Feb. (In German)

Results of 405 thyroid function tests in central Germany, using iodine-131 in a biphasic study, were reported. Horst's results were compared with the author's results. (auth)

9668

APPARATUS FOR THE ADMINISTRATION OF RADIOCOBALT SOLUTIONS IN THE BLADDER.

Umberto Cocchi (Univ. of Zurich). Strahlentherapie 108, 293-5 (1959) Feb. (In German)

An apparatus was described, which was constructed specifically for the instillation of radioactive cobalt solution for the intravesical irradiation of non-infiltrating superficial tumors and papillomas of the urinary bladder. Its use is simple and it provides a good radiation protection. (auth)

9669

EXPERIMENTAL CONTRIBUTION TO THE QUESTION OF AN INTERSTITIAL RADIATION THERAPY WITH RADIOACTIVE PREPARATIONS. Ernst Spode (Deutschen Akademie der Wissenschaften, Berlin). Strahlentherapie 108, 296-300 (1959) Feb. (In German)

The report treats of experiments with guinea-pigs on the usefulness of $\text{Ho}^{166}\text{Cl}_3$, $\text{Lu}^{177}\text{Cl}_3$ and $\text{Cr}^{52}\text{PO}_4$ in interstitial radiotherapy. The advantages and disadvantages of the various preparations are discussed. The high usefulness of Ho^{166} is particularly emphasized. (auth)

9670

SUCCESSFUL MARROW HOMOGRAFT IN THE DOG AFTER RADIATION. Joseph W. Ferrebee, Harry L. Lochte, Alfred Jaretzki, Otto D. Sahler, and E. Donnell Thomas (Mary Imogene Bassett Hospital, Cooperstown, N. Y. and Children's Cancer Research Foundation, Boston). Surgery 43, 516-20 (1958) Mar.

A functioning marrow graft showing female-type leukocytes in the percentage characteristic of normal females has been secured in a male dog. The pre-radiation, radiation, and post-radiation procedures and the reasons for them are outlined and discussed. Barring the possibility of active acquisition of tolerance from unusual and unlikely placental communication during interuterine life, the graft falls in the category of successful post-radiation homograft. (auth)

9671

THE INFLUENCE OF X-RAY IRRADIATION ON THE FERMENTO-SECRETORY PROCESSES IN THE INTESTINES. M. F. Nesterin (Inst. of Nutrition, Academy of Medical Sciences, U.S.S.R.). Vestnik Rentgenol. i Radiol. 32, 81-3 (1957) July-Aug. (In Russian)

The results of experiments with dogs exposed to 200, 400, and 600 r showed various fermento-secretory reactions. The secretion enterokinase and phosphatase content increases with exposure to 200 and 400 r and drops at 600 r. The content of saccharase drops at 400 and 600 r, while the content of the lipase and polypeptidase does not change with exposures to 200, 400, and 600 r. (R.V.J.)

9672

INVESTIGATIONS ON THE EFFECT OF PHOTOSYNTHESIS ON THE EXCHANGE MECHANISM WITHIN THE HEXOSE MOLECULES. Otto Kandler and Martin Gibbs (Brookhaven National Lab., Upton, N. Y.). Z. Naturforsch. 14b, 8-13 (1959) Jan. (In German)

Position marked glucose (glucose-1- C^{14} , -2- C^{14} , -6- C^{14}) was added to *Chlorella* suspensions, and after a long incubation in darkness or in light under various gas phases, the glucose synthesized to polysaccharide was extracted. By decomposition with *Leuconostoc mesenteroides* the distribution of the radioactivity within the glucose molecule was determined. In darkness approximately 10% of the radioactivity was exchanged with respect to the homologous C atoms of the other hexose half. A further 10% was found in the remaining C atoms. In the light without CO_2 the exchange of the

radioactivity is considerably less than in the dark. The addition of CO_2 to the light gave an increase of the exchange to the symmetrically placed homologous C atoms, but a strong reduction of the remaining exchange processes. The known aldolase and transketolase reactions influence the distributions extensively, but not enough to explain quantitatively the distributions. The origin of an asymmetric distribution of the radioactivity in photosynthesis in C^{14}O_2 from reverse reactions of a primary symmetrically marked hexose is not possible on the basis of these results. (tr-auth)

9673

THE SIGNIFICANCE AND CALCULATION OF THE PRIMARY IONIZATION IN THE IMPACT THEORY. K. Sommermeyer and K. Philipp (Univ. of Freiburg i. B.). *Z. Naturforsch.* 14b, 33-7(1959) Jan. (In German)

In practical agreement with previous literature, 110 ev was assumed by Pollard (*Progr. Biophys.* 5, 72(1955)) for the average energy expenditure per primary ionization in biological substances. According to the experimental investigation on the primary ionization in hydrogen-rich steam, it must be assumed that in biological substances the average energy expenditure per primary ionization is at least 30% smaller than 110 ev. More probably the energy poor primary ionizations (individually produced in biological structures) possess only a vanishing effect probability. (tr-auth)

9674

RADIOISOTOPES IN SCIENTIFIC RESEARCH. VOLUME III. RESEARCH WITH RADIOISOTOPES IN HUMAN AND ANIMAL BIOLOGY AND MEDICINE. Proceedings of the International Conference held in Paris in September 1957 under the Auspices of the United Nations Educational Scientific and Cultural Organization. R. C. Extermann, ed. New York, Pergamon Press, 1958. 780p.

Fifty-nine papers are presented. Topics covered include applications of radioisotopes in investigations in the fields of pharmacology, iodine metabolism by the thyroid gland, lipid metabolism, studies of blood and blood proteins, nucleic acid metabolism, carbohydrate metabolism in the brain and nervous system, clinical physiology, and reproduction. Counting methods and tracer techniques are discussed. A complete subject index is included. (C.H.)

9675

RADIOISOTOPES IN SCIENTIFIC RESEARCH. VOLUME IV. RESEARCH WITH RADIOISOTOPES IN PLANT BIOLOGY AND SOME GENERAL PROBLEMS. Proceedings of the International Conference held in Paris in September 1957 under the Auspices of the United Nations Educational Scientific and Cultural Organization. R. C. Extermann, ed. New York, Pergamon Press, 1958. 708p.

Fifty-two papers are presented. Topics covered include applications of radioisotopes in studies on mineral metabolism in plants, translocation in plants, plant biosynthesis, and plant metabolism. Methods are discussed for measuring activity from carbon-14 used as a tracer. Results are included from tracer studies on the solubility of calcium carbonate in ocean waters, the movement of radioactive phosphorus from the mud of lakes, and metabolism in zooplankton. A complete subject index is included. (C.H.)

9676

REPORT OF THE UNITED NATIONS SCIENTIFIC

COMMITTEE ON THE EFFECTS OF ATOMIC RADIATION. Supplement No. 17 (A/3838). New York, United Nations, 1958. 231p. and 1 illus.

A survey is presented of the biological effects of radiation based upon current information received and the conclusions reached by the United Nations Scientific Committee. Information is included on the following: types and characteristics of radiation; the fundamental problems of radiobiology, their present status, and their relevance to the practical human hazards of today; somatic and genetic effects; radiation from natural and man-made sources; environmental contamination; and methods of measurement. A bibliography of the reports that were submitted to the committee is given. Included also is a map showing the world wide deposition of Sr^{90} (mid-1957). (J.H.M.)

CHEMISTRY

General

9677 AECU-4016

Anderson Physical Lab., Champaign, Ill.
PROGRESS REPORT TO THE ATOMIC ENERGY COMMISSION—JANUARY 1959. Technical Report No. 6. 27p. Contract AT(11-1)-544. \$4.80(ph), \$2.70(mf) OTS.

The original zone melting apparatus has been converted from a one-zone to a six-zone operation. It has continued to be used for work with intentionally doped and reagent grade KCl. Another one-zone refiner has been constructed. This refiner has been used for work with KBr. The experiments that have been performed to date with these two refineries are discussed. Two other means of purification are also discussed. These methods are ion exchange and distillation. Work on the analysis of the salts is discussed. It is apparent that various gases like O_2 , CO , CO_2 , etc., may be analyzed by vacuum fusion. The same is true for water. This means that one will be able to determine whether or not the band at 204 μ is related to the water content of the crystals. If so, then the crystals can be analyzed spectrophotometrically at this wave length. It also appears possible to employ the hollow cathode to analyze for the cation impurities with a sensitivity of the order of a few thousandths of a part per million. (For preceding period see AECU-3899.) (auth)

9678 AECU-4035

Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes.

KINETICS OF THE PLATINUM-CATALYZED HYDROGEN REDUCTION OF AQUEOUS COBALT SULFATE-AMMONIUM ACETATE SOLUTIONS. Technical Report No. XXXV. R. Ted Wimber and Milton E. Wadsworth. Jan. 31, 1959. 53p. Project No. 1. Contract AT(11-1)-82. \$9.30(ph), \$3.60(mf) OTS.

Cobalt sulfate solutions containing ammonium acetate and chloroplatinic acid were reduced by hydrogen in a pyrex-glass-lined autoclave at 170 to 232°C and hydrogen partial pressure range of 115 to 830 psia. The reduction rate was directly proportional to the hydrogen partial pressure and surface area of the pyrex glass and was independent of the quantity of chloroplatinic acid added initially. Experiments involving the variation of the relative concentration of ammonium acetate indicated that the reducible cobalt complex was the diace-

tate complex of cobalt, $\text{Co}(\text{Ac})_2 \cdot 4\text{H}_2\text{O}$, which was in solubility equilibrium with a pink precipitate, $\text{Co}(\text{Ac})_2 \cdot 4\text{H}_2\text{O}$. In accordance with the experimental findings a mechanism was proposed in which hydrogen adsorbed on a surface site and reacted slowly with a cobalt complex in the solution phase to produce an intermediate which decomposed to yield cobalt metal. The cobalt sulfate-ammonia and cobalt sulfate-ammonium acetate reduction systems were compared and were found to be reduced with about equal ease. Type 316 stainless steel and Carpenter 20 were shown to be catalysts for the hydrogen reduction of the two systems, respectively. (auth)

9679 AECU-4049

Stanford Research Inst., Menlo Park, Calif.
MECHANISMS OF SURFACE ADSORPTION IN HOMOGENEOUS REACTOR LOOPS. Semi-Annual Report No. 2 for July 1 to December 31, 1957. H. J. Eding. 36p. For Oak Ridge National Lab. SRI Project No. SD-2080-2. Contract W-7405-eng-26, Subcontract 1081. \$6.30(ph), \$3.00(mf) OTS.

Homogeneous reactor operating conditions in which solids and deposits are formed on loops were examined. Methods of removing existing deposits are also considered. Experiments were conducted to study the characteristics of solids and deposits on type-347 stainless steel and on Zircaloy-2 specimens using simulated homogeneous reactor solutions in a rocking autoclave. Ferric and chromic sulfate were added to the solution in some of the tests to form solids by hydrolysis. Four tests were run at 300°C, while other tests were conducted with temperatures cycling at 200 to 300, 240 to 300, 270 to 300, and 240 to 270°C. The deposits formed on stainless steel contained ferric-chromic oxide as the main identifiable crystalline compound. It was concluded from examination that the deposits were formed by corrosion and selective deposition. Zircaloy specimens in the same tests formed zirconia deposits by corrosion. The solids formed by hydrolysis were characterized by a large number of x-ray-diffraction lines in addition to those characteristic of ferric-chromic oxide, preferred orientation, and smaller crystalline size for solids and deposits. The particle size ranged from 1 μ to agglomerates of 100 μ . The solids were synthesized by hydrolysis of ferric, chromic, zirconium, and lanthanum sulfates. X-ray-diffraction patterns differed from those produced by corrosion, and it is concluded that the study should be directed toward fundamental processes involved in solids formation. Solids from Oak Ridge loop experiments did not produce x-ray-diffraction patterns similar to those produced in the autoclave. A study of solids formation using radiochemical means is planned. (For preceding period see AECU-4050.) (J.R.D.)

9680 AECU-4050

Stanford Research Inst., Menlo Park, Calif.
MECHANISMS OF SURFACE ADSORPTION IN HOMOGENEOUS REACTOR LOOPS. Final Report for January 1, 1957 to June 30, 1958. Harold J. Eding and E. M. Carr. June 30, 1958. 34p. For Oak Ridge National Lab. SRI Project No. SD-2080-2. Contract W-7405-eng-26, Subcontract 1081. \$6.30(ph), \$3.00(mf) OTS.

The work during the past six months, using radioisotopes, is summarized in detail, and earlier results are included as pertinent. Most of the research was performed in rocking autoclaves, using a uranyl sulfate

solution and oxygen overpressure at 250 to 300°C. The conditions were chosen to simulate homogeneous reactor test conditions without elaborate apparatus and in a reproducible manner. The suspended solids and the deposits on type 347 stainless steel and Zircaloy-2 specimens were analyzed mainly by x-ray techniques. The transport of iron from a solution to deposits and solids was proved in four tests (R-Fe-1, R-Fe-2, R-Fe-4, and R-Fe-5) in the rocking autoclave by adding iron-59 as the sulfate to a simulated HRT solution. Similarly, transport of chromium was moved in two tests (M-Cr-1 and M-Cr-2) in the micro autoclave. Transfer of iron-59 from a corroding metal surface to solids and deposits was shown in two tests using stainless steel specimens which had been activated by deuterons in a cyclotron. In test R-ISS-1, the specimen used had been irradiated with 6- to 8-Mev deuterons, and contained cobalt-56. The specimen used in test R-ISS-2 had been irradiated with 3- to 4-Mev deuterons, and contained very little interference from radioactive cobalt isotopes. The deposits on type 347 stainless steel contained ferric-chromic oxide as the main identifiable crystalline component. A consideration of weight increase, x-ray absorption of deposits, and complexity of x-ray-diffraction patterns indicated that the oxide deposit was formed by a combination of corrosion process, and selective deposition of suspended particles or ions. The main component of the deposit on Zircaloy specimens in the same tests was zirconia. These deposits occasionally also contained ferric-chromic oxide. The suspended solids formed in the current tests contained both zirconia and ferric-chromic oxide, with zirconia as the main component. Past experiments had shown mainly ferric-chromic oxide resulting from corrosion of the walls of the autoclave. (For preceding period see AECU-4049.) (auth)

9681 AERE-C/R-1321

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

THE VAPOUR PRESSURE OF PLUTONIUM TETRAFLUORIDE. C. J. Mandleberg and D. Davies. Feb. 17, 1954. 18p.

The vapor pressure of PuF_4 was measured by an effusion method in the temperature range 968 to 1589°K. At temperatures below 1450°K, the vapor pressure can be represented by the equation $\log_{10} p_{\text{mm. Hg}} = 6.005 - 10363/T^\circ\text{K}$. Above this temperature, the vapor pressure increases much more rapidly with temperature, and it is thought that this may be due to the presence of PuF_5 in the vapor formed by the reaction $2\text{PuF}_4 = \text{PuF}_5 + \text{PuF}_3$ as has been predicted by Brewer. The material remaining in the effusion pot at the conclusion of experiments above 1450°K has invariably been PuF_3 . (auth)

9682 AERE-C/R-1468

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

THE PREPARATION OF PLUTONIUM AMALGAM AND ITS REACTION WITH DILUTE HYDROCHLORIC ACID. A. G. White. June 1954. 21p.

Plutonium amalgam is best prepared by direct combination of the metal and mercury in vacuo at 200 to 300°C. The amalgam so prepared is extremely reactive and must be handled in vacuo or in an argon atmosphere. The rate at which the amalgam is decomposed by dilute solutions of HCl has been studied and is found to be dependent on surface area, stirrer speed, and temperature, and probably independent of acid concentration. The dependence on the concentration of Pu in

the amalgam is complex. Previous work on the decomposition of amalgams is reviewed. (auth)

9683 AERE-C/R-1609

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THEORY OF ION EXCHANGE—III. THE HYDRATION OF CATIONS IN POLYSTYRENE SULPHONATES.

E. Glueckauf and G. P. Kitt. Feb. 4, 1955. 38p.

The adsorption of water by the polystyrene sulfonates of cations has been investigated at 0 and 25°C, using an isopiestic method. The absorption isotherm and the heats (enthalpies) and entropies of hydration have been obtained for the monovalent cations H, Li, Na, K, Cs, NH₄, Ag, and for the divalent cations Be, Mg, Ca, Sr, Ba, and Hg. With the exception of H, which gives a smooth enthalpy-water content curve, all monovalent cations show a more or less marked step in the differential enthalpy of adsorbed water between the first and second water molecule adsorbed per ion, thereafter the steps are less clearly defined. The differential entropies show similarities to those calculated for a B.E.T. isotherm, except that the curves show two minima which correspond to approximately 0.5 and 1.5 molecules of water/ion. This would be expected if the hydration energy varies considerably between successively adsorbed water molecules. The adsorption isotherms follow more or less the model of the B.E.T. isotherm, with several significant differences: (a) the volatility of the second and further water molecule/ion is not that of liquid water, but only tends to reach this value after several molecules/ion are adsorbed, and the energy levels of the first successive water molecules, though rising rapidly, differ substantially from that of liquid water; (b) the adsorption process of the first water molecule is significantly different from a Langmuir mechanism, and varies approximately as the $\frac{1}{2}$ power of the water activity. The knowledge of the free energies, enthalpies and entropies permits a fair analysis of the hydration mechanism into its individual steps, which then permits a calculation of the standard state enthalpies and entropies of the first hydration steps. Both functions show a markedly linear relationship with the ionic radius of the unhydrated ion when summed up for the first two water molecules adsorbed. The knowledge of the absorption isotherms permits one to differentiate between water absorbed with zero free energy (swelling water) and the excess adsorbed water (cationic and anionic hydration water). The amount of hydration water associated with the cations has been obtained in this way both for mono- and di-valent ions. The amount varies both with the water activity and with temperature. It is clear from the comparatively small free energies of hydration of all monovalent ions (except the first H₂O on H⁺) that the association is very loose, at least in the presence of anions, and is not related to the coordination number of the ions. (auth)

9684 AERE-M/R-1729

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

SOLID METAL-LIQUID METAL INTERACTION STUDIES. PART II. CONTACT ANGLE RELATIONSHIPS FOR SODIUM ON SOLIDS. J. W. Taylor and S. D. Ford. Nov. 19, 1955. 26p.

Using a sessile drop technique, a study has been made of the contact angle behavior of liquid sodium on a vari-

ety of solid metals and ceramics in the temperature range 100 to 550°C. Sodium forms a contact angle of less than 90° on all the metals studied at temperatures in the range 300 to 400°C; the corresponding temperatures for the ceramics are a little higher. No dewetting of the materials occurs on cooling and this, in conjunction with the observed influence of absorbed gas on the solid surface, suggests that in the early stages the contact angle temperature relationship is not one of equilibrium. While sodium readily wets most solid materials, the solid-liquid interfacial tension is high as shown by an experimental value of 580 dynes/cm. for the sodium-copper interface; the failure of sodium to attack metals intergranularly would support the view of a high interfacial tension. The low surface tension of sodium accounts for its ease of wetting. In structures, either metallic or ceramic, in which the bond strength is weak and or, stressed, complete disruption or failure of the solid can occur when the contact angle falls below 90°. (auth)

9685 AERE-R/R-2762

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

MEASUREMENT OF THE DENSITY OF "SANTOWAX R," PARA-, META-, AND ORTHO-TERPHENYL, DIPHENYL AND DOWTHERM A. R. W. Bowring and D. A. Garton. Dec. 1958. 25p. \$0.63(BIS).

The densities of Santowax R, para-, meta-, and ortho-terphenyl, diphenyl, and Dowtherm A were measured as a function of temperature from the melting point to just above the normal boiling point. The probable accuracy of the results is estimated as $\pm 1/4\%$. Comparison with other published data, where available, shows no major discrepancies, agreement on the whole being within $\pm 1/4\%$. Because of the variation in composition of Santowax R, the density values obtained can, strictly, only refer to the particular batch of Santowax R from which the sample was taken; however, the densities of the individual isomers are sufficiently close for quite wide variations in composition not to alter the density by more than about $\pm 1\%$ from the values obtained. The effect of polyphenyls higher than terphenyl in the sample used was to raise the density by about $1/4\%$ above the value expected had these higher polyphenyls been absent. (auth)

9686 DL(S)/TN-2010

Gt. Brit. Springfields Works, Springfields, Lancs, England.

THE REMOVAL OF PEROXIDES FROM ETHER. J. A. Dukes. Dec. 13, 1951. 6p.

Methods for treating ethyl ether used at Springfields for the removal of peroxide compounds which have explosive properties are reviewed. The best method appears to be to wash the high-peroxide ether with an acid solution of ferrous sulfate. (W.L.H.)

9687 DP-316

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.

ANALYSIS FOR Np²³⁷ IN NITRIC ACID SOLUTIONS. Bruce B. Murray. Sept. 1958. 14p. Contract AT(07-2)-1. \$0.50(OTS).

A method was developed for the analysis of Np²³⁷ in nitric acid solutions that contained uranium, plutonium, and fission products. Neptunium was extracted with thenoyltrifluoroacetone after reduction to the (IV) state with ferrous sulfamate. The alpha activity of the sepa-

rated neptunium was then measured with an alpha pulse height analyzer, and the degree of separation of neptunium from other alpha emitters was determined. The precision of the analysis depended on the total amount of Np^{237} present in the sample. A relative standard deviation of 2 to 5% was observed for samples that contained more than 180 alpha disintegrations of neptunium per minute. For activities in the range of 10 disintegrations per minute the relative standard deviation was from 10 to 25%. (auth)

9688 HW-59008

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

ION EXCHANGE-SPECTROGRAPHIC DETERMINATION OF ARSENIC AND PHOSPHORUS IN RIVER WATER.

R. Ko. Jan. 21, 1959. 14p. Contract W-31-109-Eng-52. \$0.50(OTS).

An ion exchange-spectrographic method for the determination of trace concentrations of arsenic and phosphorus in river water was developed. Concentrations as low as 0.001 ppm were determined with a precision of ± 0.001 ppm (95% C. L. for a single measurement). One liter of sample was concentrated by anion exchange. Arsenic and phosphorus were eluted with 1 M nitric acid and determined in the eluant by d-c arc excitation using vanadium as the internal standard. (auth)

9689 HW-59033

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

REMOVAL OF CHLORIDE ION FROM DAREX PROCESS DISSOLVER SOLUTION. J. E. Mendel and W. W. Schulz. Jan. 12, 1959. 22p. Contract W-31-109-Eng-52. \$0.75(OTS).

The chloride ion concentration of Darex Process dissolver solutions can be reduced readily to 0.1 g/l or less by simple batch boildown with addition of nitric acid. Efficiency of chloride removal is improved by preliminary concentration of the Darex solution: two-fold concentration appears optimum. Utilization of nitric acid during boildown is improved at low boiloff rates but longer time cycles are required for adequate chloride removal. Boildown efficiency was not significantly improved by air sparging. Solvent extraction of Darex dissolver solutions with TBP-diluent solutions is a chemically feasible alternative to the batch boildown procedure for chloride separation and removal. With 30 per cent TBP-hydrocarbon diluent as extractant, chloride distribution ratios were in the range 0.05 to 0.1. Dual scrubbing—six scrubs with 3 M HNO_3 , 0.07 M UNH and three scrubs with water at an organic/aqueous volume ratio of 5/1—reduced the chloride concentration of organic phases derived from Darex solutions 0.19 to 1.9 M in HCl to 0.005 g/l. (auth)

9690 IGO-AM/S-127

United Kingdom Atomic Energy Authority. Industrial Group. Springfields Works, Springfields, Lancs, England.

THE SPECTROGRAPHIC DETERMINATION OF BERYLLIUM IN AIR BY THE ROTATING DISC TECHNIQUE. 1958. 14p.

A filter paper containing atmospheric dust is wet oxidized with sulfuric-nitric acids. A scandium internal standard is added, and the solution is spectrographed by the rotating disk technique. (auth)

9691 ISC-1038

Ames Lab., Ames, Iowa.

ANNOTATED BIBLIOGRAPHY OF α -BENZILDIOXIME.

Charles V. Banks, Michael J. Maximovich, Nelson J. Fowlkes, and Peter A. Beak. June 1958. 60p. Contract W-7405-eng-82. \$1.75(OTS).

The references are presented chronologically. The names and configurations used by each author are retained. In this regard it should be noted that the presently accepted configuration of α -benzildioxime (anti) was not proposed until 1921 and was not generally accepted until somewhat later. The syn-configuration was generally used before 1921. (auth)

9692 LA-2271

Los Alamos Scientific Lab., N. Mex.

COMPRESSIBILITY FACTORS AND FUGACITY COEFFICIENTS CALCULATED FROM THE BEATTIE-BRIDGEMAN EQUATION OF STATE FOR HYDROGEN, NITROGEN, OXYGEN, CARBON DIOXIDE, AMMONIA, METHANE, AND HELIUM. C. E. Holley, Jr., W. J. Worlton, and R. K. Zeigler. Aug. 1958. 49p. Contract W-7405-eng-36. \$1.50(OTS).

Compressibility factors and fugacity coefficients for hydrogen, nitrogen, oxygen, carbon dioxide, ammonia, methane, and helium were calculated by use of the Beattie-Bridgeman equation of state. The results are tabulated for various pressures up to several hundred atmospheres, and temperatures up to several hundred degrees, at sufficiently close intervals to allow for easy interpolation. A comparison is made of the calculated compressibility factors with the experimental values over those ranges of temperatures and pressure where the latter are available. From this comparison an attempt is made to indicate the probable reliability of the fugacity coefficients by the number of significant figures shown. (auth)

9693 MLM-1086

Mound Lab., Miamisburg, Ohio.

DENSITY AND VISCOSITY OF FUSED MIXTURES OF LITHIUM, BERYLLIUM, AND URANIUM FLUORIDES. B. C. Blanke, E. N. Bousquet, M. L. Curtis, and E. L. Murphy. Dec. 1956. 88p. Contract AT-33-1-GEN-53. \$13.80(ph), \$4.80(mf) OTS.

The density of the ternary system lithium fluoride-beryllium fluoride-uranium fluoride was investigated by determining the loss in weight of a solid of known volume immersed in the fused solution over the temperature range of the liquidus to 900°C. The viscosity of the same system over this temperature range was measured by use of a concentric cylinder viscometer. The results are assembled in tabular and graphic form. (auth)

9694 NASA-M-2-25-59E

National Aeronautics and Space Administration.

Lewis Research Center, Cleveland.

HALOGEN-CONTAINING GASES AS BOUNDARY LUBRICANTS FOR CORROSION-RESISTANT ALLOYS AT 1200°F. Donald H. Buckley and Robert L. Johnson. Mar. 1959. 27p.

The gases CF_2Cl_2 , CF_2Br_2 , CF_3Br , CF_3I , I_2 , and SF_6 were used to lubricate nickel- and cobalt-base alloys up to temperatures of 1200°F. The use of nickel-base alloys avoided the corrosion encountered in gas lubrication of ferrous alloys above 600°F. A hemispherically tipped rider under a 1200-gram load slid on a disk rotating at a speed of 120 ft/min. Effective lubricants for a cobalt-base rider sliding on a nickel-base disk at these temperatures, were CF_2Br_2 and CF_3Br . The use of CF_2Cl_2 with 1% SF_6 in the lubrication of $7\frac{1}{4}\%$ silicon-nickel rider sliding on a cobalt-base disk gave both low friction and wear. (auth)

9695 NASA-M-3-2-59E

National Aeronautics and Space Administration.

Lewis Research Center, Cleveland.

LUBRICATING PROPERTIES OF LEAD-MONOXIDE-BASE COATINGS OF VARIOUS COMPOSITIONS AT TEMPERATURES TO 1250°F. Harold E. Sliney. Feb. 1959. 22p.

Lead monoxide was the component primarily responsible for the lubricating properties of various ceramic coatings studied. Other oxides in the formulations influenced such properties as softening points, adherence to metals, hardness, vitrifying tendencies, or chemical stability. Oxidation of the base metal during coating at elevated temperatures had important and often beneficial effects. Several of the coatings protected metals against adhesive wear at test temperatures at 75 to 1250°F. Friction coefficients ranged from 0.20 to 0.37 at 75°F and from 0.08 to 0.20 at 1250°F. The sliding velocity in all experiments was 430 ft/min. (auth)

9696 NP-7335

Rio de Janeiro. Centro Brasileiro de Pesquisas

Físicas.

ANION-EXCHANGE STUDIES WITH ACTINIUM AND LANTHANIDES IN NITRATE SOLUTIONS. J. Danon. 1958. 7p. (Notas de Física Vol. IV, No. 15).

The anion exchange of Ac in trace quantities from its homolog La were studied. Experimental procedures are described, and results are discussed. It is suggested that the solubility of the double nitrates may be correlated with the adsorption of the lanthanides by resin. Thus, the solubility increases in the order $La < Ce < Pr < Nd < Sm$, which is the reverse of the adsorption of these elements by the resin. If adsorption by the anion exchange resin is determined by the stability of nitrate complexes, the solubility of the double nitrates of La and Ac decrease with the increase in the tendency toward the formation of nitrate complexes in the series. (J.R.D.)

9697 NP-7352

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

INVESTIGATION OF GRAPHITE BODIES. Progress Report No. 2 for the Period January 1, 1959 to February 28, 1959. S. W. Bradstreet. Mar. 1, 1959. 62p. Project No. G-039. Contract AF33(616)-6143.

Binder Investigation. Of the acid catalysts investigated, p-toluene sulfonic acid is superior in producing high coke residues with partially polymerized furfuryl alcohol. Some monomer content appears to be beneficial. Differential Thermal Analysis. In addition to confirming the data obtained from coke-residue trials, differential thermal analysis yields carbon residues of comparable density to those of molded bodies of the same composition. The sensitivity of furfuryl alcohol-coke mixtures to ambient pressure during carbonization is clearly shown by thermograms; the effect of increased pressure is that of repressing those reactions attended by gas evolution. Interrelation Between Physical and Mechanical Measurements. As a result of measurements of flexural strength of several hundred experimental graphite specimens it is concluded that a reasonably simple relation exists between flexural modulus and high-temperature flexural strength for small, multicrystalline, molded graphites of similar structure. This relation is influenced by the density and, consequently, the "locked-in" stresses believed to be responsible for the increase in strength with rising temperature. A Tensile Test for Brittle Materials. Investigation

of a technique for measuring tensile strength and modulus of an extruded graphite, an acrylic resin, a porcelain, and a portland cement concrete have shown that the tensile properties of these (in tensile shafts, briquets, and flexural bar specimens) are adequately reflected by those of a circular ring, diametrically compressed. The ease of loading the ring specimens and their geometry suggests their use within furnace enclosures. (auth)

9698 NP-7354

Naval Postgraduate School, Monterey, Calif.

A RADIOCHEMICAL STUDY OF ELECTROPLATING. Technical Report No. 17. Richard A. Reinhardt and Gilbert F. Kinney. June 1957. 25p.

The electroplating of silver from a radioactive solution onto a metal cathode was investigated to determine the suitability of the radioactive tracer technique for the study of irreversible electrode phenomena. It was found that when appropriate precautions are taken to assure a fixed specific activity of the plating bath and to mount reproducibly a sample in a counting chamber the radioactivity method is satisfactory for estimating the amount of plated material, if a flat surface or if a curved surface which can be flattened reproducibly is used. The statistical fluctuations appearing in the method are somewhat too large however to permit satisfactory measurements for precise quantitative studies of polarization phenomena, where small differences between large numbers are involved, at least with the techniques employed in this study. The same limitations also apply to methods based on radioautographs made from the radioactive plated material. (auth)

9699 NYO-7742

New York Univ., New York.

ABSORPTION SPECTRA OF MOLTEN SALTS.

Benson R. Sundheim and George Harrington. Mar. 9, 1959. 103p. Contract AT(30-1)-1938. \$21.30(ph), \$6.90(mf) OTS.

A study is presented which was undertaken to determine the nature of complex species in molten salt solutions. The absorption spectra of the transition metal chlorides and thiocyanates are presented. (W.L.H.)

9700 ORNL-1965

Oak Ridge National Lab., Tenn.

A FLUORIDE FUEL IN-PILE LOOP EXPERIMENT.

O. Sisman, W. E. Brundage, and W. W. Parkinson. Jan. 29, 1957. Decl. Mar. 6, 1959. 56p. Contract W-7405-eng-26. \$9.30(ph), \$3.60(mf) OTS.

An Inconel loop circulating fluoride fuel ($62\frac{1}{2}$ mole % NaF, $12\frac{1}{2}$ mole % ZrF_4 , 25 mole % UF_6 , 93% enriched) was operated at 1485°F with a temperature difference of about 35°F in the Low-Intensity Test Reactor for 645 hr. For 475 hr of this time the reactor was at full power, and fission power generation in the loop was 2.7 kw, with a maximum power density of 0.4 kw/cc. The total volume of fuel was 1290 cc (5.0 kg), and the flow through the irradiated section was 8.6 fps (Reynolds number 5500). The loop has been disassembled and has been examined by chemical and metallographic analyses. No acceleration of corrosion or decomposition of fuel by irradiation was noted, although deposition of fission-product ruthenium was observed. No mass transfer of Inconel was found, and the corrosive attack was general and relatively light. The average corrosive penetration, in the usual form of subsurface voids, was 0.5 mil; the maximum penetration was 2 to 3 mils. (auth)

9701 ORNL-2638

Oak Ridge National Lab., Tenn.

A TECHNIQUE FOR PREPARING NEPTUNIUM TARGETS OF UNIFORM CROSS SECTION. B. J. Massey.

Mar. 26, 1959. 5p. Contract W-7405-eng-26. \$0.50(OTS).

As a result of a request for targets of uniform cross section for determination of the fission cross section of neptunium, an evaporation technique was developed for preparing films of the desired uniformity. Despite the fact that neptunium is an alpha emitter, it was possible to contain the activity and to subsequently recover the neptunium. (auth)

9702 PRL-5.25

Pennsylvania State Univ., University Park. Coll. of Chemistry and Physics.

FLUIDS, LUBRICANTS, FUELS AND RELATED MATERIALS. Quarterly Report for July, August, and September 1958. Sept. 30, 1958. 85p. Contract AF33 (616)-5460.

The use of extended bulk oil oxidation tests at 347 and at 500°F to illustrate the effects of super-refining and additive susceptibility is discussed in report PRL 5.24-Jun58. Additional tests of this type are included in the present report with a super-refined paraffinic neutral and bright stock. Quinizarin and 2,2'-dipyridylamine show essentially no inhibitor effect in this type test at 347 or at 500°F. On the basis of additive studies conducted thus far with super-refined paraffinic mineral oils, the dithiocarbamate type additive appears to be the most effective oxidation inhibitor for 347°F bulk oil tests in the neutral. Phenyl-alpha-naphthylamine is as effective as any of the additives or combinations of additives in the bright stock. Data are presented to point up the advantages of super-refining mineral oils and hydrocarbons for use as base stocks. The behavior of super-refined stocks relative to thermal stability, oxidation stability, metal corrosion, and dirt formation is compared to that of conventionally refined mineral oil stocks and typical esters of the Spec. MIL-L-7808 and Spec. MIL-L-9236 type. It has been demonstrated that additional super-refining (hydrogenation) will further improve inhibitor response to oxidation at 347°F. A summary of oxidation behavior of super-refined stocks over the temperature range of 347 to 700°F is compared to that of a Spec. MIL-L-7808 type fluid. Viscosity-volatility properties and low temperature fluidity are generally less desirable for the conventionally refined mineral oils than for synthetics of the Spec. MIL-L-7808 type. To optimize the viscosity-volatility characteristics of mineral oils and hydrocarbons, a series of vacuum fractionations have been conducted. The fractionating unit used gives about three theoretical plates separation and can be operated at a head pressure of 0.5 to 1.0 millimeter mercury absolute. Materials with a normal boiling point of up to about 900 to 925°F can be distilled without appreciable cracking in this unit. The oils fractionated thus far include eight paraffinic neutrals, four super-refined naphthenic neutrals, and two partially hydrogenated condensed ring aromatic hydrocarbons. Properties of the fractions of fluids representative of each of these classes have been determined. Optimum viscosity-volatility properties are illustrated. Viscosity-low temperature fluidity relationships indicate that many conventionally refined and super-refined mineral oils and hydrocarbons exhibit extrapolated viscosity values

at the ASTM pour point in the range of 5,000 to 15,000 centistokes. By a deep dewaxing procedure, it is shown that it is possible to dewax, or remove crystalline materials, to an ASTM pour point which is equivalent to an extrapolated viscosity value of 200,000 to 500,000 centistokes. In the case of the paraffins and naphthenes, measured low temperature viscosities (0°, -25°, or -40°F.) of the deep dewaxed, fractionated, super-refined stocks are lower than those predicted by a straight line extrapolation from the ASTM viscosity-temperature chart. It is shown that a paraffinic mineral oil with the same volatility characteristics as di-2-ethylhexyl sebacate will have a -65 to -70°F ASTM pour point and a viscosity of 13,000 centistokes at a temperature of -40 to -45°F. A series of 13 esters of the neopentyl type prepared by the Food Machinery and Chemical Corporation has been obtained by this Laboratory for evaluation as high temperature fluid and lubricant base stocks. Viscosity and low temperature properties of these esters at 700°F are compared with those of Herculox 600 and Synthetics J-7 in the glass thermal stability apparatus. A modification of the thermal stability apparatus which lessens the possibility of air being drawn into the fluid is described. All of the experimental esters show a thermal stability level within the range established for neopentyl type esters. A series of used jet engine oils from tests in the J-57 engine at 300° and 350°F oil-in temperatures has been received by this Laboratory. These fluids include mineral oils, silicones, and synthetic lubricants of the Spec. MIL-L-7808 and Spec. MIL-L-9236 types. Inspection properties, thermal stability data, and oxidation behavior in the 347°F bulk oil tests have been determined for these used samples. Evidence is shown to indicate that temperatures in the range of 500 to 600°F are encountered in the J-57 engine at 300 and 350°F oil-in temperature and that the Spec. MIL-L-7808 type bulk oil oxidation test is not severe enough to predict the engine behavior of fluids and lubricants. A procedure for the quantitative analysis of the oxidized products in the used engine oil samples is outlined. Based on the ratio of volatile to liquid products in controlled laboratory tests, the oxygen assimilated by the fluids in the course of the engine tests has been estimated. A formulation for evaluation as a missile hydraulic fluid is proposed. This fluid is a modification of the experimental hydraulic fluid MLO 7243 which uses a super-refined naphthenic white oil as a base stock. A hindered phenol type oxidation inhibitor and a mild rust inhibitor are incorporated in the missile fluid. (For preceding period see PRL-5.24.) (auth)

9703 RDB(C)/TN-2

Gt. Brit. Culcheth Labs., Culcheth, Lancs, England.

THE MAGNESIUM REDUCTION OF URANIUM TETRAFLUORIDE. THERMODYNAMIC CONSIDERATIONS IN THE CHOICE OF LINING MATERIALS. W. G. O. O'Driscoll and P. A. Tee. Apr. 29, 1952. 7p.

Thermodynamic aspects of various reactions were investigated in selecting a lining material for UF_4 reduction reactors in which Mg is used. It was concluded that thorium or beryllia are most suitable; however, the possibility of reducing the reactivity of magnesium or lime for UF_4 by some form of dead burning or fusion, thus reducing the rate of reaction to a negligible value, is being considered. (J.R.D.)

9704 RDB(W)/TN-17

Gt. Brit. Windscale Works, Sellafield, Cumb., England. SAMPLING UNIT FOR HYDROFLUORINATION FURNACE PRODUCT. C. E. Delamere. Feb. 8, 1952. 9p.

A sampling method for removing 0.5 g samples of PuF_4 from a hydrofluorination furnace was developed. A description of the method is given along with results of sampling runs. Diagrams are also included. (J.R.D.)

9705 RISLEY-5197

United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Chesh., England.

LIQUID-VAPOUR EQUILIBRIA IN THE SYSTEM URANIUM HEXAFLUORIDE-CHLORINE TRIFLUORIDE. J. F. Ellis. 1958. Date of MS. July 3, 1953. 11p. (CTSC/P-103).

Liquid-vapor equilibria in the system $\text{UF}_6\text{-ClF}_3$ at 75°C were investigated. The components are partially miscible over the composition range with mole fraction hex = 0.3–0.5 at a summation vapor pressure of 109.7 psi absolute. The summation vapor pressure over the immiscible pair of saturated solutions lies between that of pure hex and that of pure chlorine trifluoride. Analysis of samples of liquid and vapor phases for various gross compositions was carried out with a sonic analyzer, a calibration curve for known hex–nitrogen mixtures being transformed to one for hex–chlorine trifluoride mixtures after determination of the ratio of the specific heats of chlorine trifluoride. At 75°C the ratio of the specific heats of chlorine trifluoride was found to be 1.255. (auth)

9706 TID-3527

Technical Information Service Extension, AEC. HYDROCLONES AND LIQUID CENTRIFUGES. A Literature Search. James M. Jacobs, comp. Mar. 1959. 7p. \$0.50(OTS).

A literature search for information concerning centrifugal devices was conducted. A listing containing 47 references to unclassified report literature dealing with hydroclones and centrifuges is presented. Availability is given for all reports. (J.R.D.)

9707 WADC-TN-58-56

Wright Air Development Center. Materials Lab., Wright-Patterson AFB, Ohio. THE EVALUATION AND ADAPTATION OF THE BROMINATION TECHNIQUE OF DETERMINING OXYGEN IN METALS. [Period covered] January 1957 to August 1957. Lois A. Keyser and Charles D. Houston. Mar. 26, 1958. 28p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: PROCEDURES FOR THE COMPOSITIONAL ANALYSIS OF AIRCRAFT MATERIALS. (AD-155821; [PB]-151250). \$1.00(OTS).

Laboratory results and discussion of the problem of determining oxygen in titanium and other metals using the technique of bromination are presented. The gravimetric bromination equipment was adapted for use with the conductometric carbon dioxide determinator so that the length of time of bromination could be shortened and a lower range of oxygen could be measured accurately. An evaluation of the method and the recommendations for its use are given. (auth)

9708 WADC-TR-57-143(Pt. III)

Midwest Research Inst., Kansas City, Mo. DEVELOPMENT OF THERMALLY STABLE SILICON CONTAINING RESINS. Period covered: November 15, 1957 to November 15, 1958. L. W. Breed, William J.

Haggerty, Jr., and Fred Baiocchi. Nov. 1958. 106p. Project Nos. 7340 and 7371. Contract AF33(616)-3675.

The synthesis and evaluation of new monomers for incorporation into silicon-containing resins are reported. The new monomers, which are mostly based on the arylendisilane structure, are selected for use in establishing polymeric units capable of imparting good high-temperature properties to silicone resin systems. The new monomers include compounds which contain two or more silicon atoms separated by various space groups. Described in the report are the following compounds: $\text{Me}(\text{EtO})_2\text{SiYSi}(\text{EtO})_2\text{Me}$ where Y is $-\text{C}_6\text{H}_4\text{C}_6\text{H}_4-$, $-\text{C}_6\text{H}_4\text{CH}_2-$, and $-(\text{CH}_2)_6-$. Other monomers are prepared which have different substituents on the organic group not used as a spacer. These monomers include the following: $\text{YC}_6\text{H}_4(\text{EtO})_2\text{SiC}_6\text{H}_4\text{Si}(\text{EtO})_2\text{C}_6\text{H}_4\text{Y}$ where Y is H-, Cl-, MeO-, and $\text{Me}_2\text{N-}$. The method of synthesis and properties of each new monomer is described in detail. Silicone-glass fabric laminates are described which contain disilylbenzene monomers and have improved flexural strengths at temperatures above 500°F . The results of screening new resins and investigating the composition and fabrication parameters in these new resin systems are included. These results are obtained by a procedure which requires relatively small amounts of experimental resin. (auth)

9709 WADC-TR-58-385

Cincinnati, Univ. Applied Science Research Lab. ENERGY OF AQUEOUS WETTING OF BULK SURFACES. Philip E. Berghausen, Robert J. Good, H. H. G. Jellinek, Walter Soller, Vincent A. Suprynowicz, Richard Close, Joseph Laukonis, Eugene Lynn, John McAndrews, and Harold Slone. Nov. 1958. 56p. Project title: SURFACE AND INTERFACE PHENOMENA OF MATTER. Task title: RESEARCH IN PHYSICAL PROPERTIES OF FILMS. Contract AF33(616)-3387. (AD-207527).

This research was carried out to gain thermochemical information of liquid-solid interfaces resulting from interaction between water and various solids. The heat of aqueous wetting of bulk surfaces such as aluminum foil was studied calorimetrically. The aqueous heat of wetting of polymers was also studied calorimetrically. The heat of immersion of aluminum foil was studied. This heat consists of an immediate heat and a slow heat. The average value of the immediate heat amounts to 980 erg/cm^2 evolved (standard deviation $\pm 320 \text{ ergs/cm}^2$). This value is rather close to the value of 679 ergs/cm^2 for alumina. Oxidized aluminum foil shows a similar immediate heat of wetting; however, the slow heat is appreciably reduced. The aqueous heats of immersion of polyvinylchloride, polystyrene, polyacrylonitrile and a copolymer of acrylonitrile with vinylchloride have been measured calorimetrically. The heats of immersion for polyvinylchloride and polystyrene are positive, that is heat is absorbed on immersion. Whether polyvinylchloride was completely purified is not known. This positive heat of immersion is due to an increase in entropy of water when adsorbed on the surface. Polyacrylonitrile shows a large negative heat of immersion; this is due to hydrogen bonding between this polymer and water. The copolymer also has a negative heat of immersion but smaller than that for polyacrylonitrile. (auth)

9710 WAPD-209

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. THE DETERMINATION OF URANIUM IN ALUMINUM-

URANIUM ALLOYS: APPLICATION OF POLARIZED ELECTRODE ENDPOINT INDICATION. W. J. Sewalk and G. W. Goward. Dec. 1958. 11p. Contract AT-11-1-GEN-14. \$0.50(OTS).

A rapid method with a coefficient of variation of 0.20% has been developed for the determination of uranium in aluminum base uranium alloys. The alloy is dissolved in hydrochloric acid, and the resultant solution passed through a Jones Reductor, aerated, and then titrated at a temperature of 90°C with standard ferric chloride solution. The titration endpoint is detected with a pair of platinum electrodes polarized with a current of 0.75 microamperes, a method of endpoint detection superior to the method which utilizes the conventional unpolarized platinum-calomel electrode pair. (auth)

9711 AEC-tr-3578

MELTING DIAGRAM OF THE SYSTEM $\text{MgO}-\text{CaF}_2$. P. P. Budnikov and S. G. Tresviyatskii. Translated by Ladislav Hanka (Ames Lab.) from *Ukrain. Khim. Zhur.* 19, 552-5(1953). 10p. \$1.80(ph), \$1.80(mf) JCL or LC.

Experiments conducted to establish the melting diagram of the system $\text{MgO}-\text{CaF}_2$ are described. A thermographic method was used to determine the eutectic of the composition. Results are tabulated and presented graphically. (J.R.D.)

9712 AEC-tr-3579

ELECTROCHEMISTRY—ON THE DEVELOPMENT OF A MERCURY CATHODE, RENEWABLE, WITH CONSTANT SURFACE AREA. Marie-Paule Simonnin and Marguerite Quintin. Translated for Phillips Petroleum Co. from *Compt. rend.* 237, 1409-11(1953). 3p. \$1.80(ph), \$1.80(mf) JCL or LC.

A polarographic cathode of constant surface and of well-defined polarization was developed by using a mercury column contained in a fine tube. Renewal is accomplished by falling mercury drops which find their way to the cathode surface from a reservoir. A stream of nitrogen, which does not disturb the cathode, is bubbled through the test solution while analysis is in progress to remove dissolved oxygen. A diagram is included. (J.R.D.)

9713 AEC-tr-3600

SEPARATION OF THE YTTRIUM GROUP INTO SUB-GROUPS ON THE BASIS OF A COMPLEX FORMER. N. S. Vagina. Translated by A. L. Monks (Oak Ridge National Lab.) from *Zhur. Neorg. Khim.* 2, 1522-7 (1957). 12p. \$3.30(ph), \$2.40(mf) JCL or LC.

The methods of separating cerium, based on the formation of compounds of high valency, were thoroughly developed. The few methods known for the separation of yttrium are very complex and lengthy, based on either a certain difference in the solubility of the simple yttrium and lanthanide compounds or on their different basicity. Recently, in the separation of the rare earth elements, methods were used which are based on complex-compounds which makes it possible to more clearly detect the individual nature of each element. Hence, for example, the fact of forming a complex yttrium fluoride in a fluoride melt of the alkaline metal points to a certain difference in the properties of yttrium from those of the lanthanides. (auth)

9714 AEC-tr-3617

THE APPLICATION OF ION EXCHANGE TO INVESTIGATION OF THE STATE OF A SUBSTANCE IN SOLUTION. II. EXPERIMENTAL PERFORMANCE OF THE

METHOD OF ABSORPTION CURVES. V. I.

Paramonova. Translated for Phillips Petroleum Co. from *Zhur. Neorg. Khim.* 3, 212-14(1958). 4p. \$1.80(ph), \$1.80(mf) JCL or LC.

The element investigated should be present in the solution in micro concentration. Its concentration can be measured with the help of a radioactive indicator. The second ion, which is exchanged with the ion of the element investigated, should be present in the solution in a constant concentration which exceeds markedly the concentration of the element investigated. The ionites used in the solution should have a constant exchange affinity under the conditions of the experiment. There should be no competing process of complex formation, particularly of hydrolysis, in the solution investigated. (W.L.H.)

9715 AEC-tr-3618

THE APPLICATION OF ION EXCHANGE TO THE STUDY OF THE STATE OF A SUBSTANCE IN SOLUTION. V. THE STUDY OF THE PROCESS OF COMPLEX-FORMATION BY ZIRCONIUM IN NITRIC ACID. V. I. Paramonova and A. N. Sergeev. Translated for Phillips Petroleum Co. from *Zhur. Neorg. Khim.* 3, 215-21(1958). 9p. \$1.80(ph), \$1.80(mf) JCL or LC.

The absorption curve method (ion exchange) has been used to study the formation of complexes by Zr and HNO_3 in solutions of constant acidity containing HClO_4 and HNO_3 . The data on the conditions for the hydrolysis of Zr which have been obtained by the ion exchange method are in good agreement with results of other studies. (W.L.H.)

9716 AERE-Trans-11/3/5/1180

CHLORINATION OF BERYLLIUM OXIDE BY CARBON TETRACHLORIDE. A. V. Novoselova and K. N. Semenenko. Translated by J. B. Sykes (U.K.A.E.A., Atomic Energy Research Establishment) from *Zhur. Neorg. Khim.* 3, 2213-14(1958). 5p. \$1.80(ph), \$1.80(mf) JCL or LC.

Chlorination of BeO by CCl_4 in a vertical reaction vessel is described. The solid to be chlorinated is suspended in the boiling layer in a finely divided state by a blast of gas from below the layer. The apparatus is described, and the reaction rate is compared with the rate in a horizontal reaction vessel. The comparison strongly favors the vertical reaction vessel. (J.R.D.)

9717 IGRL-T/W-98

ETHYLENE DIAMINETETRAACETIC ACID AS A MASKING AGENT IN ANALYTICAL CHEMISTRY. H. Flaschka. Translated by G. P. Cook (U.K.A.E.A., Windscale) from *Angew. Chem.* 69, 707-11(1957). 14p.

A comprehensive survey is given of the use of ethylenediaminetetraacetic acid as a masking agent in qualitative trace identifications, precipitations, photometric determinations, and titrations in analytical chemistry. (J.E.D.)

9718 SCL-T-237

CONCERNING THE ACTION OF NITRO SULFURIC ACID ON ORTHONITRO BENZOIC ACID. (Ueber Einwirkung Von Salpeter-Schwefelsäure auf Orthonitro-Benzoesäure.) Peter Griess. Translated by Marcel I. Weinreich (Sandia Corp.) from *Ber. deut. chem. ges.* 7, 1223-8(1874). 15p. (Includes original, 7p.). \$1.80(ph), \$1.80(mf) JCL or LC.

The action of nitro-sulfuric acid on orthonitro benzoic acid was investigated. In experiments it was found that

styphnic acid and three isomeric dinitro benzoic acids were formed. Reagent preparation is described as well as the reaction products. In addition, purification of the products is described. It was shown that the nitro-groups occupy the meta position in the ordinary dinitro-benzene. (J.R.D.)

9719

COLORIMETRIC DETERMINATION OF BORON HYDRIDES BY MEANS OF PHOSPHOMOLYBDIC ACID. William H. Hill, Jean M. Merrill, Russell H. Larsen, David L. Hill, and James F. Heacock (Univ. of Pittsburgh and U. S. Army Chemical Warfare Labs., Army Chemical Center, Md.). *Am. Ind. Hyg. Assoc. J.* **20**, 5-12(1959) Feb.

A procedure is described for the colorimetric determination of boron hydrides by means of phosphomolybdic acid. Phosphomolybdic acid reacts with various boron hydrides or derivatives thereof to form blue solutions. The intensity of the color produced is a linear function of the concentration of boron hydride involved, and it can be used for the microanalysis of the compound. (C.H.)

9720

THE DETERMINATION OF THALLIUM IN URINE AND AIR. Evan E. Campbell, Morris F. Milligan, and Jean A. Lindsey (Los Alamos Scientific Lab., N. Mex.). *Am. Ind. Hyg. Assoc. J.* **20**, 23-5(1959) Feb.

A method is described for the analysis of collected air samples or urine for thallium, with recoveries averaging 96 ± 6 per cent. Procedures are given for the preliminary preparation of samples for the preparation of the standard curve, for the oxidation of thallous ion to thallic ion, and for the extraction and measurement of the thallium-methyl violet complex. Comments pertinent to the development and use of the method are made. (auth)

9721

PARTICLE SIZE ANALYSIS BY GAMMA-RAY ABSORPTION. Charles P. Ross (E. I. du Pont de Nemours & Co., Inc., Aiken, S. C.). *Anal. Chem.* **31**, 337-9(1959) Mar.

A method for determining particle size for any sub-micron particles is described using gamma-ray absorption. Uranium oxide is analyzed and the data according to Stokes' law indicates its particle size to be about ± 0.3 micron. The only provision for analysis is that the absorption coefficients of the particles and the suspending medium differ significantly. (auth)

9722

THERMAL DECOMPOSITION OF THE RARE EARTH METAL OXALATES. Wesley W. Wendlandt (Texas Technological Coll., Lubbock). *Anal. Chem.* **31**, 408-10(1959) Mar.

A study is made of the thermal decomposition of the hydrated oxalates of terbium, dysprosium, thulium, ytterbium, and lutetium. Weight loss started between 45° to 60°C and the metal oxides were obtained between 715° to 745°C . (auth)

9723

WATER CONTENT OF TRIBUTYL PHOSPHATE BY HIGH RESOLUTION NUCLEAR MAGNETIC RESONANCE. B. B. Murray and R. C. Axtmann (E. I. du Pont de Nemours & Co., Inc., Aiken, S. C.). *Anal. Chem.* **31**, 450-1(1959) Mar.

A nuclear magnetic resonance spectroscopic technique is developed for determining the water content

of tributyl phosphate. The standard signal is furnished by the unknown itself and comparison of signals is on the basis of frequency rather than intensity. Therefore precision is not dependent upon gain stability and linearity in the spectrometer. (auth)

9724

THERMOGRAVIMETRY OF ANALYTICAL PRECIPITATES. LXVI. DETERMINATION OF HAFNIUM. Annie Dautel and Clément Duval (École nationale Supérieure de Chimie, Paris). *Anal. Chim. Acta* **20**, 154-9(1959) Feb. (In French)

A zirconium-free oxychloride of hafnium was prepared. The hafnium can be determined gravimetrically from the thermolysis curves of the precipitate. In particular, the neutral selenate, the *p*-hydroxyphenylarsenate and the mandelate were studied, and the curves obtained were compared to those plotted of the homologous zirconium derivatives. (tr-auth)

9725

COLORIMETRIC URANIUM DETERMINATION WITH ARSENAZO. James S. Fritz and Marlene Johnson-Richard (Iowa State Coll., Ames). *Anal. Chim. Acta* **20**, 164-71(1959) Feb.

A rapid and sensitive method is described for the quantitative colorimetric determination of uranium(VI). Masking agents such as EDTA, tartaric acid, or thio-glycerol make possible the determination of uranium in the presence of many foreign metal ions. If thorium is present, a preliminary extraction of uranium as the diethyldithiocarbamate is required. (tr-auth)

9726

RESORCINOL AS AN ANALYTICAL REAGENT FOR THE SPECTROPHOTOMETRIC DETERMINATION OF URANIUM. P. C. Jain and G. S. Rao (Univ. of Saugar, India). *Anal. Chim. Acta* **20**, 171-4(1959) Feb.

A spectrophotometric study of the reaction of uranyl acetate and resorcinol shows that an orange-red colored resorcinolate of composition 1:2 is formed. This color reaction can be conveniently used for the spectrophotometric estimation of uranium at pH 4.72. (auth)

9727

POLAROGRAPHIC REDUCTION OF HEXAVALENT URANIUM IN SODIUM TRIPOLYPHOSPHATE. II. ESTIMATION OF URANIUM. P. R. Subbaraman, N. R. Joshi, and J. Gupta (National Chemical Lab., Poona, India). *Anal. Chim. Acta* **20**, 190-4(1959) Feb.

A polarographic method of estimating of uranium, based on the reduction of its tripolyphosphate complex at the dropping mercury electrode, has been developed and applied to uraniferous tantaloniobates and monazite. In the presence of elements such as copper, iron, and vanadium which interfere with the cathodic step of the uranyl complex, a preliminary separation as uranyl ammonium phosphate in presence of EDTA is necessary. (auth)

9728

SPECTROPHOTOMETRIC DETERMINATION OF RUTHENIUM WITH 1-NAPHTHYLAMINE-3,5,7-TRISULFONIC ACID. Edgar L. Steele and John H. Yoe (Univ. of Virginia, Charlottesville). *Anal. Chim. Acta* **20**, 211-15(1959) Mar.

An investigation was made to determine the applicability of the osmate-naphthylamine reaction to the ruthenate system. It was found that under proper conditions, ruthenium (Ru VI) reacts with 1-naphthylamine-3,5,7-trisulfonic acid to form a water-soluble red com-

plex ion with a maximum absorbance at 530 m μ . The complex was found to be stable and to obey Beer's law over a concentration range of 0.5 to 14 ppm. The effects of pH, reagent concentration, and diverse ions were studied. The nature of the complex in solution was investigated, and a standard procedure for analysis recommended. A procedure for the removal of ruthenium from all interfering materials was developed based on well known distillation techniques. A rapid, sensitive, reproducible, and accurate method for the spectrophotometric determination of ruthenium was developed. (auth)

9729

COULOMETRIC TITRATION WITH QUINQUEVALENT URANIUM. DETERMINATION OF VANADIUM(V). S. L. Phillips and D. M. Kern (Dartmouth Coll., Hanover, N. H.). *Anal. Chim. Acta* **20**, 295-8(1959) Mar.

Vanadium(V) was determined by reduction with generated uranium(V) with an accuracy of about $\pm 0.3\%$. Amounts as small as 15 μ g were successfully titrated. The suggested pH range is 1 to 2.5. Iron(III) is reduced simultaneously with vanadium(V). (auth)

9730

THE POLAROGRAPHIC DETERMINATION OF BORIC ACID BY MEANS OF SODIUM NITRITE. H. I. Shalgosky (United Kingdom Atomic Energy Authority, Research Group, Woolwich Outstation, Eng.). *Analyst* **82**, 648-9(1957) Sept.

Boric acid in the presence of sodium sulfite and mannitol gives rise to a polarographic wave that may be used for the determination of boric acid. The results obtained when sodium nitrate is substituted for sodium sulfite in order to increase the sensitivity of the method are described. (W.L.H.)

9731

ENERGY TRANSFER IN ORDERED AND UNORDERED PHOTOCHEMICAL SYSTEMS. Gordon Tollin, Power B. Sogo, and Melvin Calvin (Univ. of California, Berkeley). *Ann. N. Y. Acad. Sci.* **74**, 310-28(1958) Nov. 12.

A qualitative discussion is presented of the theoretical aspects of energy migration, with some of the experimental criteria of this phenomenon and, finally, with its possible role in primary quantum conversion in photosynthesis. (W.L.H.)

9732

SUMMARIZED PROCEEDINGS OF A COLLOQUIUM ON X-RAY FLUORESCENCE ANALYSIS—LONDON, FEBRUARY AND APRIL 1958. F. W. J. Garton and H. M. Davis (United Kingdom Atomic Energy Authority, Woolwich Outstation, Eng.). *Brit. J. Appl. Phys.* **10**, 105-16(1959) Mar.

X-ray fluorescence as an analytical technique was the subject of a joint meeting of the Applied Spectroscopy and X-ray Analysis Groups of The Institute of Physics held in London on 21 February, 1958. A summarized account of the papers read by the principal speakers and of the ensuing discussions at the two meetings is given. (auth)

9733

SUMMARIZED PROCEEDINGS OF A CONFERENCE ON X-RAY ANALYSIS—MANCHESTER, APRIL 1958. A. Hargreaves and E. Stanley (Manchester Coll. of Science and Tech., Eng.). *Brit. J. Appl. Phys.* **10**, 116-24(1959) Mar.

The annual Spring Conference of the X-ray Analysis Group of The Institute of Physics was held

at the Manchester College of Science and Technology on 18 and 19 April, 1958. The papers and discussions ranged over a wide field including structural studies, apparatus, and techniques of analysis. (auth)

9734

THE MECHANISM OF MASS TRANSFER OF SOLUTES ACROSS LIQUID-LIQUID INTERFACES. III. THE TRANSFER OF URANYL NITRATE BETWEEN SOLVENT AND AQUEOUS PHASES. J. B. Lewis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Chem. Eng. Sci.* **8**, 295-308(1958) June.

Over-all transfer coefficients were determined for the transfer of uranyl nitrate between water and the three solvents dibutoxy diethyl ether (D.B.C.), methyl iso-butyl ketone (hexone), and a 20 per cent solution of tri n-butyl phosphate (T.B.P.) in odorless kerosene (O.K.), benzene, or carbon tetrachloride. In some experiments with D.B.C. the aqueous phase was 3N nitric acid in equilibrium with D.B.C. at 1.5N in nitric acid. Some systems gave larger transfer rates than predicted, and in all of these interfacial turbulence was observed. In the other systems the initial values of the calculated and observed coefficients were usually in good agreement, but the observed rate tended to diminish with time apparently due to the building up of an interfacial barrier. The formation of this barrier appears to depend solely on the duration of the experiment, being independent of uranyl nitrate concentration and all other experimental variables. The transfer of nitric acid alone between water and D.B.C. was investigated. No interfacial resistance was found when the transfer was from water to D.B.C., the transfer in the other direction was accelerated by interfacial turbulence. (auth)

9735

COMPLEX-FORMING REACTION OF Np^{4+} AND NpO_2^+ WITH TRILON B IN AQUEOUS SOLUTIONS. A. D. Gel'man and M. P. Mefod'eva (Inst. of Physical Chemistry, Academy of Sciences, U.S.S.R.). *Doklady Akad. Nauk S.S.S.R.* **124**, 815-18(1959) Feb. 1. (In Russian)

The complex-forming reaction of Np(IV) in HCl containing 3M $\text{N}_2\text{H}_4 \cdot \text{HCl}$ and Np(V) in HNO_3 solution was investigated. Admixtures of KCl and KNO_3 were added to sustain the ionic strength. The neptunium concentration was determined by spectrophotometric titration. (R.V.J.)

9736

INVESTIGATION OF MEASURABLE QUANTITIES OF TECHNETIUM. V. I. Spitsyn and A. F. Kuzina (Inst. of Physical Chemistry, Academy of Sciences, U.S.S.R.). *Doklady Akad. Nauk S.S.S.R.* **124**, 846-8(1959) Feb. 1. (In Russian)

The preparation of chemically pure technetium compounds, heptasulfide and ammonium pertechnetate, is described. The absorption spectra of the pertechnetate ion were studied, and measurable quantities of the heptasulfide were analyzed. The absolute activity of the recovered preparations of technetium was measured. (R.V.J.)

9737

AN INVESTIGATION OF THE COMPOSITION OF ALKALI ELEMENT URANATES OBTAINED BY A DRY PROCEDURE. K. M. Efremova, E. A. Ippolitova, Yu. P. Simanov, and V. I. Spitsyn (Lomonosov Moscow State Univ.). *Doklady Akad. Nauk S.S.S.R.* **124**, 1057-60(1959) Feb. 11. (In Russian)

A thermal and x-ray analysis was carried out for determining the conditions of formation and composition of alkali element uranates prepared by heating uranium oxides (UO_3 or U_2O_5) in air. The thermal stability of prepared uranates (Li_2UO_4 , Na_2UO_4 , K_2UO_4 , Rb_2UO_4 , Cs_2UO_4) tested for 6 hours in air at 700 to 1100°C at 100° intervals is tabulated. (R.V.J.)

9739

ACIDITY FUNCTION AND MOLECULAR COMPOSITION OF HYDROFLUORIC ACID CALCULATED FROM NUCLEAR MAGNETIC RESONANCE DATA FOR F^{19} . E. Z. Utyanskaya, A. U. Stepanyants, M. I. Vinnic, and N. M. Chirkov (Inst. of Physical Chemistry, Academy of Sciences, USSR). *Doklady Akad. Nauk S.S.S.R.* 124, 1095-8(1959) Feb. 11. (In Russian)

The chemical shifts of F^{19} nuclear magnetic resonance in various concentrations of hydrofluoric acid aqueous solutions were measured in order to obtain quantitative data on composition and acidity. It was found that the relation $f_B/f_{BH} + f_F = 1$ holds in the concentration range up to 37 M. (R.V.J.)

9739

QUANTITATIVE ANALYSIS OF URANIUM BY CHEMICAL METHODS. Maria Ördögh and Miklós Fodor. *Energia és Atomtech.* 11, 27-33(1958) Jan.-Feb. (In Hungarian)

A survey is given of the precipitation separation, complex formation, solvent extraction, evaporation, electrolytic separation, and ion exchange problems in the analytical chemistry of uranium, including gravimetric and fluoroscopic determination. (R.V.J.)

9740

METHODS FOR PREPARING REACTOR GRADE URANIUM COMPOUNDS AND ALLOYS. Elek Szabó. *Energia és Atomtech.* 11, 34-5(1958) Jan.-Feb. (In Hungarian)

Descriptions are given of methods for preparing high-purity U salts and alloys as fuel material for reactors. The methods include treatment of impure uranyl nitrate solutions with hydrogen peroxide, reduction of uranium oxides by heating in H_2 , and the preparation of UF_4 by treatment with HF. Other methods of interest include treatment with hexone or tributyl phosphate. For preparing metal, heating with CaH_2 , electrolysis of UF_4 in molten $\text{NaCl}-\text{CaCl}_2$ in graphite crucibles with Mo cathodes, or UF_4 reduction with Mg are discussed. (R.V.J.)

9741

TRITIUM. Piroska Csanyi Fodor. *Energia és Atomtech.* 11, 286-93(1958) Apr.-May. (In Hungarian)

The discovery, preparation, properties, and uses of tritium are described. (R.V.J.)

9742

THE FLUORESCENCE OF CERIUM IN SODIUM FLUORIDE BEADS. Natalija Belegišanin. *Glasnik Khim. Drushtva, Beograd* 21, 271-6(1956). (Translated from Referat. Zhur. Khim. No. 3, 1958, Abstract No. 7590)

Compounds of cerium produce fluorescence in the region 430 to 600 mμ with an intensity maximum at 470 and 517 mμ. Since cerium is fluorescent it permits one to determine it quantitatively in the presence of rare-earth elements Y and Th, which at a suitable dilution do not affect the fluorescence of Ce. If uranium is present, its preliminary separation is compulsory.

9743

EQUILIBRIUM POTENTIALS OF METALS MELTED IN ELECTROLYTES. I. EQUILIBRIUM POTENTIALS OF THORIUM IN CHLORIDE MELTS. M. V. Smirnov and L. D. Yushina (Urals Branch of the Academy of Sciences, U.S.S.R.). *Izvest. Akad. Nauk S.S.S.R. Otdel. Khim. Nauk* No. 2, 251-8(1959). (In Russian)

The equilibrium potential of thorium in chloride melts composed of 0.14 to 78% ThCl_4 was measured at 680 to 825°C. Mixtures of sodium chloride and potassium chloride with thorium dichloride behave as ideal solutions at all ThCl_2 concentrations. The temperature and concentration dependence of the thorium equilibrium potential was determined, and the oxidation-reduction potential of thorium and the equilibrium constant for the reaction $\text{Th}_{\text{melt}}^{4+} + \text{Th} \rightleftharpoons 2\text{Th}_{\text{melt}}^{2+}$ were calculated. The steady potential of thorium in melted equilibrium mixtures of $\text{KCl} + \text{NaCl}$ at 700 to 842°C was also measured. (R.V.J.)

9744

THE DEUTERIUM ISOTOPE EFFECT FOR A OXIDATION-REDUCTION REACTION BETWEEN AQUO IONS. A. Zwickel and Henry Taube (Univ. of Chicago). *J. Am. Chem. Soc.* 81, 1288-91(1959) Mar. 20.

The effect of substituting D_2O for H_2O on the rate of the reaction of Cr^{2+} with $(\text{NH}_3)_5\text{CoOH}_2^{2+}$ has been investigated. The specific rate of the reaction of Cr^{2+} with $(\text{NH}_3)_5\text{CoOH}_2^{2+}$ decreases by a factor of 3.8, and of Cr^{2+} with $(\text{NH}_3)_5\text{CoOH}^{2+}$ by a factor of 2.6, on making this change in solvent. The second reaction is known to proceed by transfer of oxygen from Co(III) to Cr(II) , and the first probably also proceeds by the same mechanism. The decrease in rate is taken to indicate that the O-H bonds in the bridging group are stretched in the activated complex; it is evident that the rate decrease does not necessarily imply transfer of hydrogen from reducing agent to oxidizing agent. The kinetics of the reaction of Cr^{2+} with $(\text{NH}_3)_5\text{CoOH}_2^{2+}$ have been re-investigated, and the data reported previously have been revised in some respects. (auth)

9745

VAPORIZATION OF BERYLLIUM OXIDE AND ITS REACTION WITH TUNGSTEN. William A. Chupka and Joseph Berkowitz (Argonne National Lab., Lemont, Ill.) and Clayton F. Giese (Univ. of Chicago). *J. Chem. Phys.* 30, 827-34(1959) Mar.

The composition of the vapor above beryllium oxide held in a tungsten Knudsen cell in the range 1900°-2400°K has been determined mass spectrometrically. The vapor consists predominantly of Be and O atoms and $(\text{BeO})_2$ and $(\text{BeO})_4$ molecules. Smaller amounts of the following molecules were detected: O_2 , BeO, $(\text{BeO})_2$, $(\text{BeO})_3$, $(\text{BeO})_4$, WO_2 , WO_3 , and $\text{WO}_x \cdot (\text{BeO})_y$ where $x = 1, 2$ and $y = 1, 2, 3$. A thermodynamic treatment of the data yielded a value of 4.6 ± 0.1 ev for the dissociation energy of the BeO molecule. Heats of vaporization have been measured for the other $(\text{BeO})_4$ molecules and the data suggest a ring structure for these molecules. The boiling point of BeO has been crudely estimated as $3850 \pm 200^\circ\text{C}$ at which temperature the vapor consists mostly of $(\text{BeO})_4$ and somewhat smaller amounts of $(\text{BeO})_2$ and $(\text{BeO})_3$. The atomization energies of the WO_2 and WO_3 molecules have been measured to be 13.6 ± 0.4 ev and 19.3 ± 0.4 ev, respectively. The dissociation energy of the WO molecule is estimated to be about 7.2 ev. (auth)

7746

ELECTRONIC STRUCTURE OF NEPTUNIUM HEXAFLUORIDE. G. L. Goodman (Harvard Univ., Cambridge, Mass.) and Mark Fred (Argonne National Lab., Lemont, Ill.). *J. Chem. Phys.* **30**, 849-50 (1959) Mar.

An analysis of NpF_6 structure based on ligand field theory is offered. The symmetries Γ_{7u} , Γ_{8u} , and Γ_{7u} are assigned to energy levels at 0, 7420, and 9290 cm^{-1} , respectively. The sign of g' is given to be negative, and levels are predicted at 23,220, and 28,000 cm^{-1} having the symmetries Γ_{8u} and Γ_{6u} , all of which agrees nicely with experimental data. (T.R.H.)

7747

LARGE REVERSE CARBON ISOTOPE EFFECT. Peter E. Yankwich and Robert W. Buddemeier (Univ. of Illinois, Urbana). *J. Chem. Phys.* **30**, 861-2 (1959) Mar.

A case of a reverse isotope effect in photolysis of $\text{H}_2\text{SO}_4 - \text{UO}_2(\text{NO}_3)_2 - \text{H}_2\text{C}_2\text{O}_4$ is reported. (T.R.H.)

7748

INVESTIGATIONS ON THE CO-ORDINATIVE POWER OF URANYL. PART III. INFRARED SPECTRA OF SOME COMPLEXES WITH β -DIKETONES. L. Sacconi, G. Caroti, and P. Paoletti (The University, Palermo, Italy). *J. Chem. Soc.* 4257-64 (1958) Dec.

Infrared absorption spectra have been obtained for a number of uranyl complexes with acetylacetone, benzoylacetone, and dibenzoylmethane, crystallized with water, ammonia, or pyridine and in the anhydrous state. Despite the complexity of the spectra the two ν_1 and ν_3 frequencies assigned to the bent form of the uranyl group have been observed for some of such compounds. In the anhydrous complexes of benzoylacetone and dibenzoylmethane such frequencies are shifted and altered in intensity probably owing to the modified crystal field of the "surroundings" of uranyl. The frequencies and the features of the absorption bands of water indicate different types of hydrogen bonding and confirm the existence of co-ordinate bonds between uranium and water molecules in the hydrated complexes. The H-N stretching vibrations of the ammonia appear to be shifted to lower frequencies, a feature regarded as characteristic of nitrogen-to-metal bonds. (auth)

7749

HIGHER COMPLEX FLUORIDES OF MOLYBDENUM. G. B. Hargreaves and R. D. Peacock (Imperial Coll., London). *J. Chem. Soc.* 4390-3 (1958) Dec.

From the interaction of molybdenum hexafluorides with alkali fluoride the salts, K_2MoF_8 , K_3MoF_9 , RbMoF_7 , RbMoOF_6 , and CsMoOF_6 have been obtained and characterized. (auth)

7750

CHLOROALKOXIDES OF TITANIUM, ZIRCONIUM, CERIUM, AND THORIUM. D. C. Bradley, R. N. P. Sinha, and W. Wardlaw (Birkbeck Coll., London). *J. Chem. Soc.* 4651-4 (1958)

Various methods for preparing metal chloroalkoxides have been explored, including reactions involving a chloroalcohol, chloroaldehyde or a chloroalkyl carboxylate. The following new compounds were prepared: $\text{Ti}(\text{OX})_4$; $\text{Zr}(\text{OX})_4$; $\text{Ce}(\text{OX})_4 \cdot \text{C}_6\text{H}_5\text{N}$; $\text{Th}(\text{OX})_4 \cdot 2\text{C}_6\text{H}_5\text{N}$; $\text{TiCl}(\text{OX})_3$; $\text{ZrCl}(\text{OX})_3$; $\text{Ti}(\text{OEt})(\text{OX})_3$; $\text{Ti}(\text{OPr}^i)(\text{OX})_3$; $\text{Ti}(\text{OY})_4$; $\text{Zr}(\text{OY})_4 \cdot 2\text{Me}_2\text{CO}$ and $\text{Ti}(\text{OX})_4$, where $\text{X} = \text{CCl}_3 \cdot \text{CMe}_2$, $\text{Y} = \text{CCl}_3 \cdot \text{CH}_2$, and $\text{Z} = \text{CH}_2\text{Cl} \cdot \text{CH}_2$. These results throw more light on the mechanism of the reac-

tion of alcohols with metal chlorides and on the structural theory for polymeric metal alkoxides. (auth)

7751

THE CHEMISTRY OF URANYL ACETYLACETONE COMPLEX. Alan E. Comyns, Bryan M. Gatehouse, and Eric Wait (Atomic Energy Research Establishment, Harwell, Berks, Eng. and University Coll., London). *J. Chem. Soc.* 4655-65 (1958) Dec.

Three crystalline modifications of uranyl acetylacetone monohydrate have been prepared and their unit-cell parameters, infrared spectra, visible spectra, and magnetic susceptibilities studied. Crystalline solvates of uranyl acetylacetone have also been prepared with ethanol, dioxan, acetylacetone, and acetophenone. The visible and ultraviolet spectra of solutions of anhydrous uranyl acetylacetone in ethanol and in benzene are presented; the compound is dimeric in benzene at 80°. The electrical conductivities of aqueous solutions of uranyl acetylacetone have been measured; at 0.2° the solutions are relatively stable and the equivalent conductivity is approximately unity at 10^{-4}M ; at 25° the solutions are rapidly hydrolyzed with deposition of $\text{UO}_3 \cdot 2\text{H}_2\text{O}$. (auth)

7752

NUCLEAR THERMODYNAMICS OF THE HEAVIEST ELEMENTS. II. B. M. Foreman, Jr. and G. T. Seaborg (Univ. of California, Berkeley). *J. Inorg. & Nuclear Chem.* **7**, 305-35 (1958).

The masses of the isotopes of the heaviest elements have been calculated from known decay data in the region, extended by means of decay energies calculated from closed decay-energy cycles and estimated from the systematics of α - and β -decay energies. The absolute values of the masses are based on the mass-spectrometrically determined mass of Pb^{208} and a few measured neutron binding energies. The half life systematics of α decay and spontaneous fission are also presented, and some predictions of the properties of as yet undiscovered nuclides are made. (auth)

7753

THE PREPARATION AND CRYSTAL STRUCTURE OF GALLIUM TRIFLUORIDE. F. M. Brewer, G. Garton, and D. M. L. Goodgame (Oxford Univ.). *J. Inorg. & Nuclear Chem.* **9**, 56-64 (1959) Jan.

The preparation of pure gallium trifluoride by heating gallium in hydrogen fluoride at 550°C is described. Modifications to existing analytical methods, which permit gallium and fluoride to be determined in the presence of one another, are also reported. The crystal structure of gallium trifluoride has been elucidated. The unit cell is a bimolecular rhombohedron of dimensions $a = 5.20 \pm 0.01\text{Å}$. $\alpha = 57.5^\circ$. There are two Ga atoms in the special positions 000; $\frac{1}{2}\frac{1}{2}\frac{1}{2}$ of $\text{R}\bar{3}\text{c}$ and six F atoms at $x, \frac{1}{2} - x, \frac{1}{4}; \frac{1}{2} - x, \frac{1}{4}, x; \frac{1}{4}, x, \frac{1}{2} - x; \bar{x}, \frac{1}{2} + x, \frac{3}{4}; \frac{1}{2} + x, \frac{3}{4}, \bar{x}; \frac{3}{4}, \bar{x}, \frac{1}{2} + x$, where $x = 0.136$. GaF_3 is isostructural with FeF_3 . Preliminary work on ammonium tetrafluogallate indicates that it is isomorphous with ammonium tetrafluoaluminate, having a tetragonal unit cell of dimensions $a = 3.71\text{Å}$, $c = 6.39\text{Å}$. (auth)

7754

OBSERVATIONS ON THE RARE EARTHS. LXVIII. PARTIAL RESOLUTION OF YTTRIUM AND GADOLINIUM ACETYLACETONATES BY MEANS OF A CHROMATOGRAPHIC TECHNIQUE. T. Moeller, E. Gulyas, and R. H. Marshall (Univ. of Illinois, Urbana). *J. Inorg. & Nuclear Chem.* **9**, 82-5 (1959) Jan.

Adsorption of yttrium or gadolinium acetylacetonate on columns of D-lactose hydrate or D-lactose, followed by elution with benzene-petroleum ether, effects partial resolution of the chelates into optically active fractions. Racemization is slow and first order. Resolution of these ionically-bonded inner complexes suggests that the conditions employed are of controlling importance rather than the nature of the bonding. (auth)

9755

THE ALPHA AND ELECTRON CAPTURE PARTIAL HALF-LIVES OF ^{242}Am . R. F. Barnes, D. J. Henderson, A. L. Harkness, and Herbert Diamond (Argonne National Lab., Lemont, Ill.). *J. Inorg. & Nuclear Chem.* 9, 105-7(1959) Feb.

The partial α half life and partial electron capture half life of the ground state of Am^{242} were measured at $32,000 \pm 1600$ years and 960 ± 50 years, respectively. The α half life of Am^{242} was found to be 7720 ± 160 years, in agreement with the more precise specific activity measurements of Wallman et al. The estimated errors are based on standard deviations. (auth)

9756

THE SOLUBILITY OF PLUTONIUM IN MERCURY. D. F. Bowersox and J. A. Leary (Los Alamos Scientific Lab., N. Mex.). *J. Inorg. & Nuclear Chem.* 9, 108-12(1959) Jan.

The solubility of plutonium in mercury was measured throughout the temperature range of 20 to 325°C. By analogy with the uranium-mercury system, it is assumed that the composition of the solid phase is PuHg_4 . The solubility, which increases from 2.10 g Pu/l Hg at 20°C to 85.7 g Pu/l Hg at 325°C, fits the equation $d(\log N_1)/d(1/T) = -\Delta H/2.303R$, where N_1 is the mole fraction of PuHg_4 in solution, T is the temperature in degrees Kelvin, ΔH is the heat absorbed when one mole of PuHg_4 is dissolved in an infinitely large quantity of saturated solution at temperature T , and R is the gas constant. ΔH is 4.33 kcal/mole in this temperature range. (auth)

9757

THE THERMAL DECOMPOSITION OF THE HEAVIER RARE EARTH METAL CHLORIDE HYDRATES. W. W. Wendlandt (Texas Technological Coll., Lubbock). *J. Inorg. & Nuclear Chem.* 9, 136-9(1959) Feb.

The thermal decomposition of the 6-hydrates of europium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium chlorides was studied on the thermobalance. The 6-hydrates began to lose water of hydration in the 65 to 95°C temperature range. Because of the decreasing basicity of the metal ions, horizontal weight levels corresponding to the anhydrous metal chlorides were not found. Instead, the decomposition curves in the 200 to 265°C temperature range corresponded to the composition $\text{MOCl} \cdot 2\text{MCl}_3$. On increasing the temperature, these compounds decomposed to form the metal oxychlorides in the 360 to 425°C temperature range. (auth)

9758

A HIGH-TEMPERATURE X-RAY INVESTIGATION OF NIOBIUM PENTOXIDE AND SOME PROBLEMS CONCERNING THE OXIDATION OF NIOBIUM. H. J. Goldschmidt (B.S.A. Group Research Centre, Birmingham, Eng.). *J. Inst. Metals* 87, 235-9(1959) Mar.

The phase transformations of niobium pentoxide have been investigated by means of high-temperature X-ray photography up to 1230°C., and it is shown that the so-

called "high-temperature" (β) allotrope is the truly stable form at all solid temperatures studied, while the "low-temperature" (α) form is metastable and in time always transforms to β . The varying rates for this process have been determined. The nominal transformation point of 900°C. has significance only at comparatively high rates of heating. The total oxidation of initially pure niobium metal is followed in sequence, the isothermal stages extending from solid solution of oxygen in niobium to Nb_2O_5 . Preferred orientation can be produced in thin films of $\alpha\text{-Nb}_2\text{O}_5$, as distinct from the random loose oxide. The α or β form of Nb_2O_5 can be stabilized by addition of certain oxides of other metals. Silica is an α stabilizer, and in the $\text{Nb}_2\text{O}_5\text{-SiO}_2$ system vitreous SiO_2 coexists with Nb_2O_5 ; the development of a coherent amorphous layer of this type is considered to be useful from the point of view of protection against oxidation and can be promoted by boride additions. (auth)

9759

DETERMINATION OF THE SOLUBILITY OF OXYGEN BEARING IMPURITIES IN SODIUM, POTASSIUM AND THEIR ALLOYS. D. D. Williams, J. A. Grand, and R. R. Miller (U. S. Naval Research Lab., Washington). *J. Phys. Chem.* 63, 68-71(1959) Jan.

Current interest in liquid metals, particularly sodium, as heat transfer media has emphasized the need for basic information on impurity solubility. Such data are important in the interpretation of corrosion and physical property experiments. The compounds resulting from partial oxidation of potassium and sodium metal have been isolated and identified as the respective monoxides. The equilibrium oxide in a sodium-potassium (NaK)-oxygen system is sodium monoxide. The various solubilities have been determined: sodium monoxide in sodium, potassium, and NaK alloys; potassium monoxide in potassium; sodium hydroxide in sodium; mixed sodium hydroxide-sodium monoxide in sodium; and sodium carbonate in sodium. Positive errors in oxide content may result from failure to account for each species of impurity if separation and analysis of a sample depends solely upon total alkalinity calculation. (auth)

9760

A REVIEW OF THE KINETICS OF THE AQUEOUS OXIDATION-REDUCTION REACTIONS OF URANIUM, NEPTUNIUM AND PLUTONIUM. T. W. Newton and S. W. Rabideau (Los Alamos Scientific Lab., N. Mex.). *J. Phys. Chem.* 63, 365-70(1959) Mar.

The kinetics of a number of aqueous oxidation-reduction reactions of uranium, neptunium and plutonium is reviewed. The results are given in terms of the net activation processes and the thermodynamic quantities of activation. The activated complexes are formed from the hydrated reactant ions with the prior gain or loss of one or more hydrogen ions: a gain in those cases where metal-oxygen bonds are broken and a loss in those cases where such bonds are formed. It is shown that the entropies of the various activated complexes depend primarily on their charges. For the reactions considered, the evidence appears to be against electron transfer over relatively large distances. Several of the reactions were studied in D_2O to obtain evidence concerning the possible operation of hydrogen atom transfer mechanisms. It is shown that these experiments will remain inconclusive until the effect of D_2O on solvation is understood. (auth)

9761

ISOTOPIC EXCHANGE REACTIONS IN LIQUID SULFUR DIOXIDE AND RELATED NON-AQUEOUS SYSTEMS. T. H. Norris (Oregon State Coll., Corvallis). *J. Phys. Chem.* **63**, 383-9(1959) Mar.

Results of isotopic exchange experiments suggest the desirability of a modification of the formal solvent systems interpretation of the chemistry of liquid sulfur dioxide. While sulfite exchanges readily with the solvent, thionyl halides show no significant exchange, indicating the non-formation of thionyl ions. Further experiments indicate rather ions of the type SOX^+ from thionyl halides. Sulfur trioxide exchanges oxygen readily but sulfur scarcely at all with the solvent. A mobility of oxide ions in acidic or basic solutions is inferred. Ionic halides catalyze the thionyl halide-sulfur dioxide exchange, apparently via basic halide catalysis, mobile halide ions here being indicated. Acid chlorides also show catalysis, though much less strongly, a different mechanism being involved. Acid and basic chlorides mutually inhibit each other's catalytic effect through formation of non-catalytic complex ions. The solvent concentrated sulfuric acid exchanges radiosulfur with sulfur dioxide only at high temperature. Rate measurements suggest some common features with the liquid sulfur dioxide system, particularly with regard to the sluggish $\text{S}^*\text{O}_2-\text{SO}_2$ exchange. The results emphasize the utility of the Lewis interpretation for understanding acid-base phenomena in sulfur dioxide solutions. (auth)

9762

TETRAHEDRAL NiCl_4^- ION IN CRYSTALS AND IN FUSED SALTS. SPECTROPHOTOMETRIC STUDY OF CHLORO COMPLEXES OF NICKEL(II) IN FUSED SALTS. Dieter M. Gruen and Robert L. McBeth (Argonne National Lab., Lemont, Ill.). *J. Phys. Chem.* **63**, 393-7(1959) Mar.

The absorption spectra of Ni(II) isomorphously substituted for Zn(II) in crystals of Cs_2ZnCl_4 and of NiCl_2 dissolved in fused pyridinium chloride, LiCl , CsCl , Cs_2ZnCl_4 and $\text{LiNO}_3-\text{KNO}_3$ eutectic have been obtained. The spectra show that Ni(II) is present as the tetrahedral NiCl_4^{2-} ion in fused pyridinium chloride, CsCl and Cs_2ZnCl_4 . Spectral changes observed in fused LiCl were interpreted as arising from tetragonal distortion of the NiCl_4^{2-} ion due to the large effective crystalline field in this solvent. Addition of chloride ion to solutions of Ni(II) in $\text{LiNO}_3-\text{KNO}_3$ eutectic results in the formation of chloro complexes of Ni(II). (auth)

9763

MOLTEN SALT THERMOCELLS. Benson R. Sundheim and Joseph Rosenstreich (New York Univ.). *J. Phys. Chem.* **63**, 419-22(1959) Mar.

The determination of the thermopotential of the thermocell $\text{Ag}/\text{AgNO}_3/\text{Ag}$ is described. The contributions to the thermopotential are analyzed. Some speculations on the significance of the results are presented. (auth)

9764

GAS CHROMATOGRAPHY WITH HYDROGEN AND DEUTERIUM. Carl O. Thomas and Hilton A. Smith (Univ. of Tennessee, Knoxville). *J. Phys. Chem.* **63**, 427-32(1959) Mar.

Partial resolution of the components of a hydrogen-deuterium mixture was obtained by gas-elution chromatography. The fixed phase was palladium deposited on quartz and the carrier gas was argon. The

separation of the two components was less than that which might be expected from a comparison of the elution peaks for pure hydrogen and for pure deuterium. Thus, the partition coefficient for either component of the mixture is not independent of the presence of the other component. This conclusion was further verified by the fact that following a series of runs with hydrogen it was necessary to "condition" the column by several runs with deuterium before a reproducible value for the retention volume of deuterium could be obtained. The experimental results reported by Glueckauf and Kitt in which a sample of very pure deuterium was obtained by the displacement and by the frontal techniques was verified. (auth)

9765

HYDROLYTIC BEHAVIOR OF METAL IONS. IX. ULTRACENTRIFUGATION OF Sn(IV) IN ACIDIC CHLORIDE AND PERCHLORATE SOLUTIONS. James S. Johnson and Kurt A. Kraus (Oak Ridge National Lab., Tenn.). *J. Phys. Chem.* **63**, 440-1(1959) Mar.

The results of ultracentrifugation studies of Sn^{4+} in acidic chloride and perchlorate solutions are given as degree of polymerization versus HCl concentration in excess of Sn(OH)_4 . (T.R.H.)

9766

DETERMINATION OF NIOBIUM AND TANTALUM IN TITANIUM-BASE ALLOYS. John L. Hague and Lawrence A. Machlan. *J. Research Natl. Bur. Standards* **62**, 53-7(1959) Feb.

A procedure for the determination of niobium and tantalum in titanium-base alloys is described. The sample is dissolved in a mixture of hydrochloric and hydrofluoric acid, and oxidized with a minimum of nitric acid. The resulting solution is transferred to a column containing a strong quaternary amine anion-exchange resin (Dowex-1). Titanium and other alloying elements, except niobium and tantalum, are removed by elution with an ammonium chloride-hydrochloric-hydrofluoric acid solution. Niobium is removed by elution with an ammonium chloride-hydrofluoric acid solution. Tantalum is collected in a separate eluate of slightly acid ammonium chloride-ammonium fluoride solution. Boric acid is added to complex the fluoride, the earths acids precipitated with cupferron, ignited to the pentoxides, and weighed. (auth)

9767

RADIOMETRIC ESTIMATION OF TRACES OF THORIUM IN THE PRESENCE OF QUADRIVALENT CERIUM AND LANTHANUM. K. R. Kar and B. C. Sawhney (Delhi Univ.). *J. Sci. Ind. Research (India)*, **B 18**, 39-40(1959) Jan.

A radiometric method is described for Th based on the solubility of trivalent Ce and La pyrophosphates in 0.3N mineral acid while Th pyrophosphate is insoluble. H_2O_2 in 0.3N HNO_3 served to reduce the Ce and La and allow precipitation of Th on AgSCN carrier. The method is rapid and accurate to $\pm 1\%$. (T.R.H.)

9768

THE ISOTOPE EFFECT OF DEUTERIUM IN THE WATER-GAS REACTION. L. Knop and J. Fegeš. "J. Stefan" Inst. Repts. (Ljubljana) **5**, 41-8(1958) Oct. (In German)

The H/D isotope disproportionation in the water-gas reaction was investigated using ignited charcoal and electrolytically enriched water. The separation factor in the temperature range from 400 to 620°C was deter-

mined. The effect of the contact time of the carbon material with the water vapor was also examined. (tr-auth)

9774

PREPARATION OF URANIUM SAMPLES FOR MASS SPECTROMETRIC ANALYSIS. J. Slivnik and A. Zemljic. "J. Stefan" Inst. Repts. (Ljubljana) 5, 49-51(1958) Oct.

The preparation of uranium hexafluoride for mass spectrometric analysis of U_3O_8 is described. The method may be used for routine work. The time required to prepare the sample of 80 mg is about 1 hour with an average yield of 92%. (auth)

9770

THE DETERMINATION OF DEUTERIUM OXIDE IN WATER BY FREEZING POINT MEASUREMENTS. Fodor-Czan' Tsike. Magyar Kem. Folyoirat 63, No. 2-3, 95-6(1957). (Translated from Referat. Zhur. Khim. No. 3, 1958, Abstract No. 7637)

The possibility of determining simply and rapidly 2.5 to 82% of D_2O in water by measuring the freezing point is demonstrated. An ordinary device for the freezing point measurement was used. The volume of the analyzed liquid is 8 to 10 ml. The accuracy of the temperature measurement is $\pm 0.005^\circ$. The mixture D_2O-H_2O behaves like an ideal mixture, the freezing point of which is a linear function of concentration so that repeated work for a standard curve is not required. The results of the determination do not depend on the degree of supercooling within 0.8 to 2.9° limits. The determination error of D_2O is $\pm 0.13\%$ absolute. The method is especially suitable at high concentrations of D_2O ($> 10\%$).

9771

RAPID DETERMINATION OF NIOBIUM IN STAINLESS STEEL. R. St. J. Emery. Metallurgia 59, 101-3(1959) Feb.

A spectrophotometric procedure is described whereby the niobium content of 18-8 type stainless steels can be determined in an hour and a half. Details are given of the method of separation of the niobium, and of the precautions to be taken in the presence of interfering elements. (auth)

9772

PURIFICATION OF CARBON OR GRAPHITE ARTICLES. A. W. Beeston (to Union Carbide Corp.). British Patent 798,644. Nuclear Eng. 4, 146(1959) Mar.

Impurities (boron, magnesium, calcium) are removed by subjecting carbon or graphite at elevated temperature (2,200 to 2,600°C) to a gaseous or vaporous fluorinating agent (fluorine, hydrogen fluoride, or a halogenated hydrocarbon which forms fluorine at this temperature). Fluorine-derivatives of the impurities are removed as vapor or gas.

9773

DISTRIBUTION OF BORON IN CELLS OF DICOTYLEDONOUS PLANTS IN RELATION TO GROWTH. John Skok and Wayne J. McIlrath (Argonne National Lab., Lemont, Ill. and Univ. of Chicago). Plant. Physiol. 33, 428-31(1958) Nov.

Boron determinations were made on intracellular fractions separated by differential centrifugation. Mitochondria and microsomes were found to be lower in boron than nuclei, plastids and dialyzed supernatant fractions. The boron content of the nondialyzable

supernatant fraction does not change in response to decreasing amounts of available boron accompanied by the appearance of boron deficiency symptoms. The boron content of the dialyzable portion of the supernatant fraction, however, declines when supplies of available boron decline and it finally reaches zero in this fraction when plants exhibit pronounced boron deficiency symptoms. (auth)

9774

GAMMA-RAY SENSITIVITY OF SILVER CHLORIDE EMULSIONS. Yoshitada Tomoda. Repts. Govt. Chem. Ind. Research Inst. Tokyo 53, 422-8(1958) Dec.

Silver chloride emulsions were prepared in three different compositions, and their gamma-ray sensitivity and light sensitivity were studied. It is suggested that the gamma-ray sensitivity of the emulsions depends to some extent upon the sensitivity in the higher light exposure region. It was also demonstrated that latent image fading of silver chloride emulsions depends on the nature of gelatin in emulsions, and fading phenomena are not affected by the temperature of mixing of emulsions. (C.H.)

9775

THERMAL DECOMPOSITION OF RARE EARTH FLUORIDE HYDRATES. Wesley W. Wendlandt (Texas Technological Coll., Lubbock) and Bernard Love (Research Chemicals, Inc., Burbank, Calif.). Science 129, 842(1959) Mar. 27.

A thermogravimetric study of the thermal decomposition of La, Nd, Sm, Gd, Dy, Er, and Y fluoride hydrates shows that minimum dehydration temperatures are from 315 to 405°C; conversion of the fluorides to oxyfluorides begins in the 600 to 690°C temperature range. (auth)

9776

THE SURFACE CHARGE AND SEDIMENTATION OF THORIA SUSPENSIONS. PART 1. THE ELECTROPHORETIC BEHAVIOUR OF THORIA PARTICLES IN AQUEOUS SOLUTIONS OF ACIDS, ALKALIS AND VARIOUS SALTS. H. W. Douglas and J. Burden (Univ. of Liverpool). Trans. Faraday Soc. 55, 350-5(1959) Feb.

The electrophoretic behavior of thoria particles in solutions of HNO_3 , H_2SO_4 , $(COOH)_2$, $NaOH$, Na_2CO_3 , NaF , $Th(NO_3)_4$, and UO_2SO_4 was determined, over the concentration range 10^{-3} to 10^{-1} M, using a micro-method. The results, presented in the form of zeta potential against \log_{10} (molarity) and charge density against \log_{10} (molarity) plots, are consistent with preferential ion adsorption according to the sequence $Th^{4+} > UO_2^{2+} \approx SO_4^{2-} > H^+ \approx OH^- > F^- > Na^+$, and NO_3^- . The effective adsorption sites are possibly the same for all ions. (auth)

9777

THE SURFACE CHARGE AND SEDIMENTATION OF THORIA SUSPENSIONS. PART 2. THE SEDIMENTATION OF DILUTE AND CONCENTRATED SUSPENSIONS IN RELATION TO PARTICLE SIZE AND THE VERWEY-OVERBEEK THEORY OF SOL STABILITY. H. W. Douglas and J. Burden (Univ. of Liverpool). Trans. Faraday Soc. 55, 356-62(1959) Feb.

A study was made of the sedimentation behavior of some thoria suspensions in aqueous solutions of HNO_3 , $Th(NO_3)_4$, $NaOH$, and UO_2SO_4 , electrolytes which have been found to lead to markedly different zeta potential values (both in magnitude and sign). Preliminary ob-

servations were made, using a sedimentation balance, of the behavior of dilute suspensions of two thorium samples of mean particle size $\sim 1.2 \mu$ radius and $\approx 0.2 \mu$ radius, respectively. In the light of the results obtained further observations were made of the sedimentation rate and sedimentation volume of concentrated suspensions of the finer material in HNO_3 , NaOH , and UO_2SO_4 over the concentration range 10^{-6} to 10^{-1} M. The results were interpreted in terms of variation in the effective size of the sedimenting particles and correlated with the stability against aggregation of the primary particles as indicated by the Verwey-Overbeek theory. (auth)

9776

COLORIMETRIC DETERMINATION OF THORIUM AND URANIUM BY POTASSIUM IODATE. E. S. Przheval'skii, A. P. Golovina, and E. P. Nikolaeva. *Vestnik Moskov. Univ. Ser. Mat. Mekhan. Astron. Fiz. i Khim.* **13**, No. 1, 171-5(1958). (In Russian)

A method is suggested for the colorimetric determination of thorium and uranium(IV) in which the elements are precipitated as iodates and subsequently dissolved and reduced by potassium iodate. The iodide liberated by the reduction is extracted by chloroform or carbon tetrachloride, and the resulting solutions are then colorimetrically determined. On the basis of the data obtained, it was assumed that the thorium iodate has a standard iodate formula. (R.V.J.)

9779

THE PRACTICE AND APPLICATION OF NUCLEAR RESONANCE SPECTROSCOPY. R. E. Richards (Physical Chemistry Lab., Oxford). *Spectrochim. Acta* **14**, 5-16(1959) Jan.

The principle of NMR, the equipment used, and its applications in chemistry are discussed. (T.R.H.)

9780

NUCLEAR MAGNETIC RESONANCE IN PETROLEUM ANALYTICAL RESEARCH. Rollie B. Williams (Humble Oil and Refining Co., Baytown, Texas). *Spectrochim. Acta* **14**, 24-44(1959) Jan.

Discussions are presented of the analytical process using high resolution nuclear magnetic resonance spectrometry, and of the use of spectra to elucidate molecular structure. Examples are given of the application of the nuclear magnetic resonance technique to simple multicomponent determinations, complex hydrocarbon type characterizations, and total hydrogen determinations. (auth)

9781

ON THE EFFECTS OF CERTAIN ADMIXTURES ON THE INTENSITY OF NIOBIUM AND TANTALUM SPECTRAL LINES. N. I. Tarasevich and A. D. Khlystova. *Vestnik Moskov. Univ. Ser. Mat. Mekhan. Astron. Fiz. i Khim.* **13**, No. 1, 215-22(1958). (In Russian)

The effects of alkali salts, alkaline earth metals, sesquioxides of iron and aluminum, and silicon and silicon dioxide on the intensity of niobium and tantalum spectral lines in a carbon arc were studied in order to determine the most effective admixture for improving the sensitivity of the direct spectral determination of niobium and tantalum in their oxides. (R.V.J.)

9782

PREPARATION OF THE NITRIDES OF BORON, ALUMINUM, GALLIUM, AND INDIUM. Th. Renner (Siemens-Schuckertwerke AG, Erlangen, Ger.). *Z.*

anorg. u. allgem. Chem. **298**, 22-33(1959) Jan. (In German)

From the corresponding chlorides and ammonia, the nitrides of boron, aluminum, gallium, and indium were prepared in a coarsely crystalline state by means of the van Arkel-de Boer process. The nitrides, being extremely resistant to chemical reagents, are semiconductors; the electric conductivities increase from BN, AlN, GaN to InN. (auth)

9783

THE OVER-ALL HYDROLYSIS EQUILIBRIUM CONSTANT OF THE TETRAFLUOROBORATE ION BF_4^- . I. G. Ryss and D. B. Donskaya (Dnepropetrovsk Inst. of Transportation). *Zhur. Fiz. Khim.* **33**, 107-11(1959) Jan. (In Russian)

Determination of the equilibrium constant of the reaction $\text{KBF}_4^{\text{cryst}} + 3\text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{BO}_3^{\text{cryst}} + 3\text{H} + 4\text{F}^- + \text{K}$ gave a value $\log K' = 23.15 \pm 0.1$ at 25°C . It was calculated for the reaction $\text{BF}_4^- + 3\text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{BO}_3^{\text{cryst}} + 3\text{H} + 4\text{F}^-$ at 25°C $\log K = 20.01 \pm 0.1$; $\Delta F_{238}^\circ = 27.27 \pm 0.14$ kcal. The standard free energy of formation of BF_4^- is -352 kcal/mole. (auth)

9784

THE THERMODYNAMIC PROPERTIES OF STRONTIUM SELENATE. N. M. Selivanova and G. A. Zubova (Mendeleev Inst. of Chemistry and Tech., Moscow). *Zhur. Fiz. Khim.* **33**, 141-6(1959) Jan. (In Russian)

The solubility of strontium selenate in water was determined over the temperature range 0 to 100°C . The heats of precipitation of this salt from aqueous solutions were measured calorimetrically. From the data obtained the following thermodynamic quantities of strontium chloride were calculated: free energy change on precipitation of SrSeO_4 from aqueous solutions and the heats of precipitation of this salt, the free energy and heats of formation of strontium selenate from the elements under standard conditions, the absolute entropy of SrSeO_4 , and the entropy of the selenate ion in water. (auth)

9785

THE THERMAL DISSOCIATION OF VANADIUM PENTOXIDE. B. N. Spitsyn and L. L. (Tomsk State Univ.). *Zhur. Fiz. Khim.* **33**, 180-3(1959) Jan. (In Russian)

A study was made of the thermal dissociation of vanadium pentoxide over the range of temperatures of catalytic oxidation (370 to 466°C). The validity of the Erofeev-Kolmogorov equation for describing the experimental data is shown, the activation energy thus being calculable. The value was found to be 8.6 kcal/mole. The amount of oxygen evolved agrees with data on the high and low temperature dissociation of vanadium oxide. The Laue Roentgenogram of vanadium pentoxide was found to remain unchanged on heating from 20 to 460°C , whereas a chemical reaction occurring on the monocrystal will distort its structure. (auth)

9786

THE INFLUENCE OF BORON FLUORIDE ON THE CATALYTIC ACTIVITY OF ALUMINUM OXIDE AND ALUMINOSILICATES. T. V. Antipina and E. N. Avdonina (Lomonosov Moscow State Univ.). *Zhur. Fiz. Khim.* **33**, 192-6(1959) Jan. (In Russian)

A kinetic study was made of the dehydration of ethyl alcohol on aluminum oxide and aluminosilicate and of the cracking of cumene on aluminosilicate, all treated with boron fluoride. It was shown that the adsorption of BF_3 ,

while increasing the activity of the catalysts, does not change to a first approximation the mechanism either of the hydration or of the cracking reactions. The treatment of aluminum oxide with boron fluoride was shown to lead to the formation of a surface chemical compound possessing a high activity with respect to the cracking of cumene. It was also shown that this surface compound is destroyed by the products of dehydration of ethyl alcohol. (auth)

9777

PROCEEDINGS OF THE CONFERENCE ON LUBRICATION AND WEAR, LONDON, OCTOBER 1st-3rd, 1957. London, The Institution of Mechanical Engineers, 1957. 918p.

The papers presented at this conference include: hydrodynamic lubrication; journal bearing instability; marginal and partial hydrodynamic lubrication; friction of solids; boundary lubrication; bearing materials, solid lubricants, surface treatments, and seals and glands; lubrication of rotating bearings and gears; internal combustion engine lubrication, miscellaneous lubricants, applications, and additives; and wear. (W.L.H.)

9788

RADIOISOTOPES IN SCIENTIFIC RESEARCH. VOLUME II. RESEARCH WITH RADIOISOTOPES IN CHEMISTRY AND GEOLOGY. Proceedings of the International Conference held in Paris in September 1957 under the Auspices of the United Nations Educational Scientific and Cultural Organization. R. C. Extermann, ed. New York, Pergamon Press, 1958. 759p.

Fifty-two papers are presented. Topics covered include applications of radioisotopes in studies in organic chemistry, recoil chemistry, analytical chemistry, physical chemistry, geophysics, the extraction of fission products from chemical process wastes, and the separation of isotopes from fission products. A complete subject index is included. (C.H.)

Radiation and Radiochemistry

9789 AERE-I/M-53

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE PRODUCTION AND SEPARATION AT A.E.R.E., HARWELL OF ^7Be , ^{52}Mn , ^{148}Pm , ^{46}V , ^{85}Sr , ^{199}Au , ^{111}Ag , ^{233}Pa . C. E. Mellish and J. A. Payne. Feb. 1959. 5p. \$0.16(BIS).

Four of the nuclides are made in the Harwell cyclotron (^7Be , ^{52}Mn , ^{148}Pm , and ^{46}V), one in the Birmingham cyclotron (^{85}Sr), and the other three (^{199}Au , ^{111}Ag , and ^{233}Pa) by the (n,γ) reaction followed by β decay in nuclear reactors at Harwell. Radiochemical methods are given for the separation of the above nuclides from their targets. (W.L.H.)

9790 AERE-I/R-2693

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE SEPARATION AND PURIFICATION OF KRYPTON-85 AT THE MULTI-CURIE LEVEL. E. J. Wilson and K. J. Taylor. Dec. 1958. 22p. \$0.56(BIS).

A description is given of a remote-controlled glass apparatus capable of separating 25 curies of Krypton-85 per working day from dissolver gas containing 10 ppm v/v Krypton-85. (auth)

9791 GA-617

General Atomic Div., General Dynamics Corp., San Diego, Calif.

SZILARD-CHALMERS PROCESSES. Quarterly Status Report [for] September 15-December 14, 1958. Rodman A. Sharp. Dec. 16, 1958. 14p. Project No. 49. Contract AT(04-3)-167, Project Agreement No. 3. \$3.30(ph), \$2.40(mf) OTS.

Further experiments were performed on Szilard-Chalmers systems measuring yields and enrichments. Work was done on 15-hr Na^{24} , 38-min Cl^{38} , 12-sec F^{20} , 2.6-hr Mn^{56} , 12-hr Cu^{64} , 14-hr Zn^{60} , and 27-hr Sn^{121} . The irradiations were accomplished in the rotary specimen rack of General Atomic's TRIGA Reactor. The thermal neutron flux at this position was 2×10^{13} nvt/kw-hr. (W.D.M.)

9792 MND-P-2513

Martin Co. Nuclear Div., Baltimore.

SNAP-III—THERMOELECTRIC GENERATOR RADIOLOGICAL SAFETY ANALYSIS. George P. Dix, Thaddeus J. Dobry, Jr., and Paul Guinn. Feb. 1959. 27p. \$4.80(ph), \$2.70(mf) OTS.

A radiological safety analysis is presented for the SNAP-III thermoelectric generator. Since the fuel of the device is polonium-210, a toxic radioisotope, certain safety measures have been designed into the device and its shipping container to prevent a release of the contaminant into any environment during normal operation or a catastrophic accident. Once containment is assured, the direct radiation problem is considered. It has been shown that the direct radiation from the thermal source is kept within tolerance limits by surrounding materials and spatial and temporal factors. It must be emphasized that this device should not be deliberately abused or mishandled since this would serve to increase the probability of accident. The device has been evaluated with respect to internal forces such as heat and helium pressure and external forces such as impact and chemical attack. The mechanical, thermal and chemical integrity of the thermoelectric generator is shown to be quite reliable. The basic physical, chemical, thermal, atomic and nuclear characteristics of polonium-210 have been presented. Potential internal and external radiation hazards have been set forth. (auth)

9793 ORNL-128

Oak Ridge National Lab., Tenn.

DECOMPOSITION OF TRITIUM OXIDE UNDER ITS OWN RADIATION. J. A. Ghormley and A. O. Allen. Sept. 1, 1948. 25p. Contract W-7405-eng-26. \$4.80(ph), \$2.70(mf) OTS.

Water in which 2 to 19% of the hydrogen is replaced by tritium decomposes into hydrogen and oxygen as a result of bombardment by the tritium beta rays. The decomposition stops as a result of back reaction when the pressure of gaseous products reaches values which vary from 20 to 600 or more cm Hg, depending apparently on the nature and amount of impurities present. The steady-state pressure of electrolytic gas is generally lowered by increase of temperature (to an extent varying for different samples) and by exposure to gamma rays. The decomposition continues when the water is frozen and kept at liquid nitrogen temperature. He^3 formed by tritium decay diffuses through the walls of fused silica vessels, but not through soft glass; and the activity of a tritium oxide sample can readily be determined by collecting and measuring the pure helium which comes out through the walls of a silica container. (auth)

9794 ORO-191

Florida State Univ., Tallahassee.

RADIATION INDUCED EFFECTS IN HETEROGENEOUS ORGANIC SYSTEMS. Progress Report for Period March 15, 1957 to February 15, 1958. Russell H. Johnsen. 12p. Contract AT(40-1)-2001. \$3.30(ph), \$2.40(mf) OTS.

The effects of 2.7-Mev tritons on several organic acids were investigated. The technique used employed the addition of LiCl to various organic acids with subsequent irradiation by slow neutrons. The tritium entry in the parent compound was measured, and the effect of radical scavengers on entry percentage was examined as well as the radiation stability of carboxylic acids. Results are tabulated. (For preceding period see ORO-190.) (J.R.D.)

9795 ORO-192

Florida State Univ., Tallahassee.

RADIATION INDUCED EFFECTS IN HETEROGENEOUS ORGANIC SYSTEMS. Progress Report for Period February 15, 1958 to December 1, 1958. Russell H. Johnsen. 30p. Contract AT(40-1)-2001. \$4.80(ph), \$2.70(mf) OTS.

The interaction of aliphatic hydrocarbons with metals under the influence of gamma radiation is described. Nine carboxylic acids were irradiated to investigate the mechanism of gamma-ray-induced decomposition of the acids. (W.L.H.)

9796 WSI-R-40

Gt. Brit. Windscale Works, Sellafield, Cumb., England. THE DETERMINATION OF $\beta\gamma$ ACTIVITY OF LIQUIDS BY ABSORBING ON TISSUE, WITH SPECIAL REFERENCE TO BUTEX SOLUTIONS. F. J. Armson and T. H. English. Aug. 13, 1952. 12p.

A new method of $\beta\gamma$ counting has been developed which is suitable for butex and aqueous samples containing mainly high energy components. It should be applicable to all liquids which wet tissue unless chemical or physical attack takes place. Low energy sources containing only one species if accompanied by a strong γ component may be determined by γ scintillation counting. If not, a self-absorption correction can probably be applied. The method does not appear to be easily applicable to mixtures of low energy β radiations. The procedure is quite suitable for butex samples, and for solutions containing volatile fission products. The wet tray method is more rapid and gives more precise results than does direct evaporation. Results by 8 operators indicated a precision of about 12%. By careful handling, no additional safety hazard is involved. (auth)

9797 AERE-Trans-11/3/5/1037

THE TASKS AND POSSIBILITIES OF PREPARATIVE RADIATION CHEMISTRY. G. O. Schenck. Translated by E. Wait (U.K.A.E.A., Atomic Energy Research Establishment) from *Angew. Chem.* 69, 579-99(1957). 79p. \$12.30(ph), \$4.50(mf) JCL or LC.

A survey is presented of radiochemical processes. The syntheses of various organic compounds using ionizing radiation is presented. (W.L.H.)

9798

PREPARATION OF STANDARD RADIUM SOLUTIONS FROM RUMANIAN NATURAL SOURCES. A. Szabo, Ester Dely, and Ana Szabó. (Academy of Sciences of Rumania). *Acad. rep. populare Romine, Inst. fiz. atomică IFA/R/7* 6p.(1956). (Translated from *Referat. Zhur. Khim.* No. 14, 1958, Abstract No. 45855.)

The method of Ra extraction from Rumanian

calcareous tuffs is described. A weighed sample of tuff is dissolved in HCl, and Ba chromate is precipitated from the solution at pH7. An addition of Fe producing hydroxide furthers the precipitation. The precipitate is washed and dissolved in HCl. Ba sulfate is precipitated by H_2SO_4 , washed and calcined with alkali metal carbonates, washed with water, and dissolved in HCl. To eliminate all the traces of Fe, it is precipitated with ammonia. Ba and Ra are precipitated by the addition of $(NH_4)_2CO_3$, washed and dissolved in HCl. Two standard solutions each containing 4×10^{-12} g of Ra were obtained of 1 kg of tuff.

9799

QUANTITATIVE RADIOCHEMICAL ANALYSIS BY ION EXCHANGE. ANION EXCHANGE BEHAVIOR IN MIXED ACID SOLUTIONS AND DEVELOPMENT OF A SEQUENTIAL SEPARATION SCHEME. Leon Wish (U. S. Naval Radiological Defense Lab., San Francisco). *Anal. Chem.* 31, 326-30(1959) Mar.

A sequential separation method is devised for determining neptunium, plutonium, uranium, zirconium, niobium, and molybdenum in mixed fission products. The sample is concentrated in hydrochloric acid and added directly to the anion exchange column. The activities are measured by a multichannel gamma ray spectrometer. (auth)

9800

QUANTITATIVE RADIOCHEMICAL ANALYSIS BY ION EXCHANGE. ANION EXCHANGE EQUILIBRATIONS IN PHOSPHORIC ACID SOLUTIONS. E. C. Freiling, Juan Pascual, and A. A. Delucchi (U. S. Naval Radiological Defense Lab., San Francisco). *Anal. Chem.* 31, 330-1(1959) Mar.

Phosphoric acid solutions are applicable for the quantitative separation of tellurium from uranium and neptunium on Dowex 2 anion exchange resin. The equilibrium distribution coefficients for fission products are established. (auth)

9801

DETERMINATION OF RADIOACTIVE CESIUM. Thomas H. Handley and Cecil L. Burros (Oak Ridge National Lab., Tenn.). *Anal. Chem.* 31, 332-4(1959) Mar.

An improved method for the separation and determination of cesium-136 and cesium-137 is devised. Cesium is precipitated with sodium tetraphenylborate and finally determined by gamma scintillation spectrometry. Interfering materials are removed by precipitation with ferric hydroxide and sodium carbonate. (auth)

9802

STRONTIUM-90 BY AN ION EXCHANGE METHOD. E. A. Bryant, J. E. Sattizahn, and Buddy Warren (Los Alamos Scientific Lab., N. Mex.). *Anal. Chem.* 31, 334-7(1959) Mar.

An ion exchange method is described for determining strontium-90 in fission products which have decayed at least 10 days. The strontium-90 is adsorbed on a cation-resin column and time allowed for the growth of yttrium-90 which is selectively eluted. Yttrium-90 is purified on a cation-resin column, eluted, and counted after evaporation of the effluent. (auth)

9803

ESTIMATION OF RADIOACTIVE CALCIUM-45 BY LIQUID SCINTILLATION COUNTING. Leo Lutwak

(National Institutes of Health, Bethesda, Md.). Anal. Chem. **31**, 340-3(1959) Mar.

A liquid scintillation counting method is developed for determining radioactive calcium-45 in biological materials. The calcium-45 is extracted, concentrated, and dissolved in absolute ethyl alcohol to which is added 0.4% diphenyloxazol in toluene. Counting efficiency is about 65 percent with standard deviation of ± 7.36 percent. (auth)

7804

THE RADIATION PROTECTIVE EFFECTS OF AET ON THE ENZYME CREATINE PHOSPHOKINASE. Donald R. Anderson (School of Aviation Medicine, U. S. Air Force, Randolph Air Force Base, Texas). Arch. Biochem. Biophys. **81**, 390-4(1959) Apr.

Aqueous solutions of creatine phosphokinase are inhibited by Co^{60} γ radiation. A G value of 0.47 was obtained with an enzyme concentration of 1.7×10^{-6} M. Protection against gamma radiation was obtained with S-(2-aminoethyl)isothiuronium (AET) salts. A protective mechanism involving a shielding linkage with biological molecules is suggested. (auth)

7805

MEASUREMENT OF Ni^{63} WITH A 2 π PROPORTIONAL COUNTER. J. R. MacEwan, J. U. MacEwan, and L. Yaffe (McGill Univ., Montreal). Can. J. Chem. **37**, 649-54(1959) Apr.

Measurement of Ni^{63} , a β^- emitter with very low maximum energy, is described. External absorption curves were determined in aluminum and a range 8.5 ± 0.5 mg/cm² was found. This corresponds to a maximum energy of the β radiation of 72.7 ± 2.5 kev, in reasonably good agreement with values obtained by other methods. Self-absorption curves of electrolytically deposited samples were obtained and attempts made to compare these with the theoretical predictions of Gora and Hickey. (auth)

7806

AN IONIC MECHANISM IN THE RADIOCHEMICAL POLYMERIZATION OF 2,4,4-TRIMETHYL-1-PENTENE. Eve de Gorski and Gabriel de Gaudemaris. Compt. rend. **248**, 969-71(1959) Feb. 16. (In French)

The polymer formed by 2,4,4-trimethyl-1-pentene under the action of accelerated electrons was analyzed. The triisobutylene fraction contains two hydrocarbons also present in the product obtained by chemical methods in acid medium. This seems to indicate, for radiochemical polymerization, an ionic mechanism, which is confirmed by other experimental facts. (tr-auth)

7807

MECHANISM OF LOW-TEMPERATURE POLYMERIZATION OF MONOMERS WHEN ACTED UPON BY GAMMA RAYS. A. P. Sheinker, M. K. Yakovleva, E. V. Kristal'nii, and A. D. Abkin (Karpov Research Inst. of Physics and Chemistry). Doklady Akad. Nauk S.S.S.R. **124**, 632-4(1959) Jan. 21. (In Russian)

The low-temperature polymerization mechanism of various vinyl compounds acted upon by γ radiation was studied. The kinetic data and combined polymerization of isobutylene with vinylidene chloride (in mass) in the temperature interval -78 to 0°C and methylmethacrylate with styrene in ethyl chloride as solvent at -78° to $+25^\circ\text{C}$ supplied the data on the nature of active particles (radicals and ions) which accomplish the polymerization processes. The data show that the composition of produced polymer complexes changes sharply with the

change in polymerization temperature. Moreover, at high temperature (0°) combined polymers are enriched with chlorovinylidene components and at low temperatures with isobutylene components. Especially significant is the fact that enrichment increases with temperature drop from -40 to -78°C . Consequently, the observed conversion of monomer relative reaction properties indicates a different mechanism (radical and ions) in low-temperature polymerization under the effects of γ radiation. In separate styrole polymerization at $+25$ to -78°C the rate of polymerization diminishes at first and then increases. The rate of the process at -78°C is higher than at $+78^\circ\text{C}$. (R.V.J.)

7808

THE STRUCTURE AND CATALYTIC ACTIVITY OF Al_2O_3 - ZrO_2 -CATALYSTS AS INFLUENCED BY COMPOSITION AND THERMAL TREATMENT CONDITIONS. A. M. Rubinshtein, V. A. Afanas'ev, V. M. Akimov, N. A. Pribytkova, and K. I. Slovetskaya (Zelinskii Inst. of Organic Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. **124**, 1076-9(1959) Feb. 11. (In Russian)

The disintegration of absolute isopropyl alcohol in Al_2O_3 - ZrO_2 catalyzers prepared by coprecipitation of corresponding volumes of 10% nitrate solutions and 10% ammonium solutions at room temperature and pH 8.7 to 9.5 was studied at 400 to 750°C . The x-ray data indicate that γ - Al_2O_3 stabilizes the ZrO_2 tetragonal structure and considerably increases the temperature of the phase transformation into monocline structure. (R.V.J.)

7809

NATURE AND ROLE OF INTERMEDIATE PRODUCTS IN THE RADIOLYTIC REDUCTION OF NITRATE.

V. A. Sharpatyi, V. D. Orekhov, and M. A. Proskurnin (Karpov Research Inst. of Physics and Chemistry). Doklady Akad. Nauk S.S.S.R. **124**, 1279-81(1959) Feb. 21. (In Russian)

The nitrate yield dependence on γ -ray dose was studied in 1 M nitrate and NaOH solutions in the dose range 0.04 to 1000 r/sec. The nitrate yield in air-saturated solutions remains constant at all doses and equals ~ 3 ekv/100 ev. With 0.5 to 1000 r/sec doses in the absence of oxygen (the solution was saturated with nitrogen), the nitrate yield rises to ~ 8 ekv/100 ev. With 2.5% oxygen in a gas mixture of oxygen-nitrogen, the G_{NO_2} solution dependence is proportional to the dose rate logarithm. The solutions were irradiated at various temperatures in order to determine the nature and the part played by the intermediate products in nitrate reduction. (R.V.J.)

7810

DETERMINATION OF THE URANIUM AND THORIUM CONTENT IN MINERALS BY MEANS OF RADIATION MEASUREMENTS. Dezső Kiss and Zoltán Zamori. Energia és Atomtech. **11**, 12-18(1958) Jan.-Feb. (In Hungarian)

Descriptions are given of classical and modern methods of U and Th determination in ores, including the approximate measurements of α activity, G. Becquerel's method, γ radiation measurements, and emanation methods using ionization chambers and other instruments. (R.V.J.)

7811

POLAROGRAPHIC ANALYSIS OF URANIUM IN PHOSPHORIC ACID. De-Yao Tsai. Hua Hsüeh Hsüeh

Pao 23, 79-89(1957). (Translated from Referat. Zhur. Khim., No. 12, 1958, Abstract No. 39069.)

At H_3PO_4 concentrations of less than 0.5 M, UO_2^{2+} produces two waves with $E^{1/2}$ being approximately -0.12 and 0.26 v. The first wave corresponds to the reduction of UO_2^{2+} to UO_2^+ ; the second wave corresponds to the reduction to U^{4+} . With an increase in the H_3PO_4 concentration, the first wave is increased so that the total height of the two waves is not changed. At H_3PO_4 concentrations greater than 0.5 M, only one wave remains. Because of the inconsistency of $K\sqrt{\eta}$, where K_2 is the constant of the diffusion current and η is the viscosity, a conclusion was reached concerning the formation of a complex of UO_2^{2+} with H_3PO_4 . A method was devised for U analysis in high concentrations of H_3PO_4 . In determining UO_2^{2+} and U^{4+} in the presence of each other, UO_2^{2+} is first determined polarographically; then the solution is titrated with permanganate, and the total U is then determined polarographically, together with a determination of U^{4+} by difference.

9812

SOVIET RADIOCHEMISTRY. A. N. Murin (Academy of Sciences of the U.S.S.R., Moscow). Intern. J. Appl. Radiation and Isotopes 5, 15-20(1959) Feb.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 10449.

9813

CYCLOTRON-PRODUCED CARRIER-FREE RADIO-ISOTOPES. Thick Target Yield Data and Carrier-free Radioisotopes. Irwin J. Gruverman and Paul Kruger (Nuclear Science and Engineering Corp., Pittsburgh). Intern. J. Appl. Radiation and Isotopes 5, 21-31(1959) Feb.

A program has been undertaken for the production, processing, and distribution of cyclotron-produced, carrier-free radioisotopes on a world-wide basis. Although cyclotron-produced radioisotopes are inherently more expensive than reactor-produced radioisotopes, several conditions are enumerated under which their use is desirable, and in many cases mandatory. Several new isotopes, previously considered difficult to obtain, are now readily available. Procedures are detailed for the separation of 17 radioisotopes in carrier-free form: Be^7 , Na^{22} , V^{48} , Mn^{52} , Mn^{54} , Fe^{55} , Co^{57} , Zn^{65} , Ga^{67} , As^{74} , Sr^{85} , Y^{88} , Cd^{109} , In^{111} , Ce^{136} , W^{181} , and Bi^{207} . Thick target yields are given for production of these radioisotopes from cyclotron irradiations with deuterons of 15 Mev energy and with protons of 8, 15, and 20 Mev energies. (auth)

9814

RADIOLYSIS OF NORMAL HEPTANE AND ITS INHIBITION BY DIBENZYL SULFIDE AND DIBENZYL ADDITIONS. A. M. Brodskii (Brodsky), Yu. A. Kolbanovskii (Kolbanovsky), E. D. Filatova, and A. S. Chernysheva (Tchernysheva) (Inst. of Oil, Academy of Sciences, of the U.S.S.R., Moscow). Intern. J. Appl. Radiation and Isotopes 5, 57-62(1959) Feb.

Kinetic investigations of normal heptane γ radiolysis were carried out over a wide dose range. The composition of gases from radiolysis was studied in detail. The inhibiting effect of small additions (5×10^{-4} M) of dibenzyl and dibenzyl sulfide was determined. A decrease in the amount of unsaturated gases and the appearance of isomeric structures with increase of the integral dose rate was observed. (auth)

9815

ELECTRON SPIN RESONANCE SPECTRA OF THE CARBOXYHYDROXYMETHYL RADICAL TRAPPED AFTER γ -IRRADIATION OF GLYCOLLIC ACID. P. M. Grant, R. B. Ward and D. H. Whiffen (Univ. of Birmingham, Eng.). J. Chem. Soc. 4635-7(1958) Dec.

Electron resonance spectroscopy is used to identify the radical obtained on the irradiation of crystalline glycollic acid with gamma rays as carboxyhydroxymethyl, $\text{HO}\cdot\text{CH}\cdot\text{CO}_2\text{H}$. (auth)

9816

THE CHEMICAL EFFECTS OF γ -RADIATION ON ORGANIC SYSTEMS. PART I. THE SYSTEMS PYRIDINE-BROMOBENZENE AND ANILINE-BROMOBENZENE. G. A. Swan and P. S. Timmons (Univ. of Durham, Newcastle Upon Tyne, Eng.). J. Chem. Soc. 4669-72(1958) Dec.

Gamma irradiation of a mixture of pyridine and bromobenzene afforded 2-, 3-, and 4-phenylpyridine, as well as pyridine hydrobromide. From an irradiated mixture of aniline and bromobenzene, 2- and 4-aminodiphenyl, azophenine, and aniline hydrobromide were isolated. These reactions are apparently initiated by homolysis of bromobenzene under the influence of γ rays. (auth)

9817

THE CHEMICAL EFFECTS OF γ -RADIATION ON ORGANIC SYSTEMS. PART II. THE ACTION OF RADIATION ON BENZYL ALCOHOL ALONE OR MIXED WITH ACETONE OR BROMOBENZENE. G. A. Swan and D. Wright (Univ. of Durham, Newcastle Upon Tyne, Eng.). J. Chem. Soc. 4673-80 (1958) Dec.

Irradiation of benzyl alcohol with γ rays gave rise to benzaldehyde, dibenzyl, 1:2-diphenylethanol, and meso- and racemic hydrobenzoin. In the presence of acetone, the last two compounds were produced in considerably greater energy yield. The products formed by the irradiation of a mixture of benzyl alcohol and bromobenzene were also investigated. (auth)

9818

A SEMIMICROTECHNIQUE FOR IRON⁵⁹ BETA DE-TERMINATIONS IN BIOLOGIC MATERIALS. T. P. Leffingwell, G. S. Melville, Jr., and R. W. Riess (Univ. of Texas and U. S. Air Force, Balcones Research Center, Austin, Texas). J. Lab. Clin. Med. 53, 622-8(1959) Apr.

After acid digestion of iron-containing components of biologic systems, the iron may be selectively complexed and extracted from the digest. The colored complex is of adequate stability to permit spectrophotometric measurement of total iron. If iron 59 is also present in the system, the same colored complex may be introduced into a liquid scintillator solution and the beta emanations counted with an efficiency of from 35 to 40 per cent at the concentrations of iron derived from blood. The technique offers a net increase in counting efficiency of from five- to sixfold as compared to the commonly used gamma counting technique, a reduction in size of the initial sample up to one-fifteenth, and a substantial, but unquantitated, increase in the precision of counting. (auth)

9819

A RAPID METHOD FOR S^{35} RADIOASSAY AND GRAVIMETRIC SULFUR DETERMINATION IN BIOLOGIC MATERIAL. Joseph Katz and Sybil B.

Golden (Cedars of Lebanon Hospital, Los Angeles).
J. Lab. Clin. Med. **53**, 658-64(1959) Apr.

A wet-ashing procedure for the combustion of biologic material to sulfate and the assay of S^{35} activity is described. The conditions for the perchloric-nitric acid combustion of tissues have been investigated, and the procedure has been simplified to permit the routine simultaneous determination of sulfur and the assay of sulfur- 35 activity in a large number of samples. Sulfate is precipitated as barium sulfate and plated on glass filter paper. Use of glass filter paper eliminates the difficulties commonly encountered in the handling of such precipitates for both gravimetric sulfate determination and assay of radioactive sulfate. (auth)

9820

ANION-EXCHANGE STUDIES. XXV. THE RARE EARTHS IN NITRATE SOLUTIONS. Y. Marcus and Frederick Nelson (Oak Ridge National Lab., Tenn.).
J. Phys. Chem. **63**, 77-9(1959) Jan.

Adsorbabilities of several rare earths—La, Ce, Pr, Nd, Pm, Sm, Eu, Tb and Yb—in slightly acidified lithium nitrate solutions have been investigated with a strong base anion-exchange resin. Adsorbabilities increase with increasing lithium nitrate concentration, and the lighter rare earths are more strongly adsorbed than the heavier. Sufficient differences in adsorbabilities were found to permit separation of the lighter rare earths with relatively short columns. (auth)

9821

HETEROPHASE RADIATION POLYMERIZATION OF ISOBUTENE AND METHYL METHACRYLATE. R. Worrall and S. H. Pinner (Tube Investments Research Labs., Essex, Eng.). *J. Polymer Sci.* **34**, 229-42(1959) Jan.

The rate of the ionic polymerization of isobutene, induced at low temperatures by high energy radiation, is considerably increased when the reaction is carried out in the presence of certain inorganic compounds, notably metal oxides, of high surface area. The acceleration is not accompanied by a corresponding increase in the molecular weight of the polymer. The rate of polymerization of methyl methacrylate when exposed at room temperature to electrons at high intensity is increased by the presence of polyethylene powder. A consideration of the mechanisms of acceleration under heterogeneous conditions leads us to believe that the increase in rate in the first case is due to an increase in the rate of initiation and in the second case to a decrease in the bimolecular termination rate constant. (auth)

9822

GRAFT COPOLYMERIZATION BY PRE-IRRADIATION TECHNIQUE. D. Ballantine, A. Glines, G. Adler, and D. J. Metz (Brookhaven National Lab., Upton, N. Y.). *J. Polymer Sci.* **34**, 419-38(1959) Jan.

Trapped free radicals are formed when polyethylene is irradiated with cobalt-60 gamma rays in the absence of any reactive species—oxygen, monomer, etc. The net free radical population formed increases with increasing total dose, decreasing temperature of irradiation, and increasing crystallinity of the polymer. Upon addition of a monomer to these vacuum-irradiated films, the monomer will graft copolymerize. Graft copolymers produced by this technique are the most homogeneous, compared to those formed using other radiation-induced techniques. If oxygen is present during the irradiation, many of the free radicals formed

are consumed in reaction with the oxygen to produce peroxides, hydroperoxides, and other oxygen-containing groups. The ratio of trapped free radicals to those reacted with oxygen increases with increasing crystallinity of the polyethylene. When films irradiated in air are subsequently contacted with monomer, grafting occurs, even at room temperature, and increases in rate at higher temperatures. It is believed that the initiation of grafting in these films is accomplished by trapped radicals and peroxide decomposition. The graft copolymers formed by this technique are not as homogeneous as those formed in the vacuum irradiation technique, but are far more homogeneous than those formed in either of the simultaneous irradiation-grafting techniques. (auth)

9823

SYNTHESIS OF GRAFTED COPOLYMERS FROM POLYMERS IRRADIATED BY IONIZING RADIATIONS. II. EFFECT OF THE PREIRRADIATION CONDITIONS ON THE KINETICS OF GRAFTING OF POLYETHYLENE. Adolphe Chapiro. *J. Polymer Sci.* **34**, 439-59 (1959) Jan. (In French)

The influence of dosage and intensity of pre-irradiation upon the grafting reaction of vinyl monomers has been studied in the case of polyethylene films which were previously irradiated in the presence of air. Several types of radiations were used for irradiation of the films: gamma rays from Co-60, 37-kv x rays, and accelerated electrons at 2 Mev. The irradiated films were heated *in vacuo* in the presence of monomer, at 80 and 135°C. During grafting the films become regularly thicker in all three dimensions without changing the over-all external shape, even at high degrees of grafting. It was found that the rate of grafting at a given temperature was a linear function of time of preirradiation for doses up to 10 megarads; for the higher doses the rate of grafting is limited. On the other hand, films pre-irradiated in the presence of air and irradiated *in vacuo*, lose their activity toward grafting. For a given dosage of irradiation, the rate of grafting is highest when the intensity of pre-irradiation is smallest. All these results confirm the hypothesis, previously formulated, that irradiation in the presence of air produces peroxide groups in the polymer. These polymeric peroxides are themselves sensitive to radiolysis and decompose at high doses. The kinetics of the grafting reaction agrees with a polymerization reaction initiated with macroperoxides. This polymerization proceeds in a highly viscous polymeric medium, which slows down the termination reaction and produces effects analogous to those called gel effect. Moreover, the necessity for the monomer of penetrating into the polymeric film complicates the phenomena, the instantaneous concentration of the monomer at the loci of reaction being controlled by diffusion. The influence of the side chains of the high pressure polyethylene on the radiochemical peroxidation has been studied by comparison with grafting carried out on low-pressure polyethylene and polypropylene. The results show that the presence of tertiary hydrogen atoms in polypropylene enhances the formulation of hydroperoxides, while biperoxidic structures prevail in the case of linear polyethylene. All the results are discussed. (auth)

9824

IRRADIATION GRAFTING OF STYRENE TO HIGH PRESSURE AND LOW PRESSURE POLYETHYLENE FILMS. Allan S. Hoffman, E. R. Gilliland, E. W.

Merrill, and W. H. Stockmayer (Massachusetts Inst. of Tech., Cambridge). *J. Polymer Sci.* **34**, 461-80(1959) Jan.

The cobalt-60 gamma irradiation of high pressure and low pressure (Marlex-50) polyethylene films immersed in styrene monomer to produce graft polymers was studied as a function of dose, temperature, and film thickness. It was found that grafting generally increased with dose, but reached a level for all films at 10 to 20°C and an average dose rate of 228,000 rad/hr, where the grafting was higher for the thinnest films (1.5 to 2 mils) than the thicker films (up to 20 mils). At 40 and 70°C and an average dose rate of 93,500 rad/hr, the grafting increased approximately linearly with dose for all films. The post-effects were also studied and found to be more significant for higher film thickness, higher polymer crystallinities, and lower temperatures. Observations of the heterogeneity found in the grafted films were described, photos were shown, and these effects were discussed. It was concluded that for the dose rates employed, grafting was probably diffusion-controlled for all films at 10 to 20°C and perhaps for the thicker films at 40°C. The effects of changes in the various independent and dependent variables on the grafting mechanism were discussed and a qualitative picture of this mechanism was described. It was then concluded that the different polycrystalline natures and different thicknesses of the films (as they affected the monomer diffusion rate), and the dose rate or rate of initiation of free radicals were among the most important factors in determining the mechanism and resultant efficiency of grafting. (auth)

7825

PREPARATION OF GRAFTED COPOLYMERS OF POLYTETRAFLUOROETHYLENE (TEFLON) BY RADIATION CHEMISTRY. Adolphe Chapiro. *J. Polymer Sci.* **34**, 481-501(1959) Jan.

It was previously found that different polymers may be grafted onto polytetrafluoroethylene by irradiating this polymer in the presence of vinyl monomers. However, because of the high chemical stability of Teflon, no monomer is able to penetrate inside this polymer in the usual way, and therefore the grafting remains limited to the surface. It was found that if the grafting of Teflon proceeds with a monomer under well-defined experimental conditions in which the graft copolymer swells, the grafting can propagate progressively into the material, and finally a graft copolymer is obtained which is entirely homogeneous. This reaction was studied by grafting on films of Teflon, styrene, and methyl methacrylate monomers. During grafting the monomeric films swell regularly in three dimensions without modification of their over-all shape. However, if the styrene content in the films exceeds 90 wt. %, the films crack because of the strains caused by the swelling of the grafted film in styrene. The kinetics of this reaction is controlled by the diffusion of the monomer in the partially grafted films. The plots of the degree of conversion versus time show an acceleration of the reaction with time. These may be represented by the empirical equation $C\% = At^\alpha + B$, in which t is the time and α has a value generally between 2 and 3. If the rate of monomer diffusion is lower than the rate of polymerization, the grafting is limited on the surface of the film; if the rate of polymerization is diminished while the rate of diffusion is maintained constant, grafting becomes possible through all the material. The influence of several

parameters on the kinetics of the reaction has been studied. Thus, the intensity of irradiation, the monomer concentration, and the temperature are most important. Teflon films of different thicknesses were grafted in these conditions. Intermittent irradiation also enhances the grafting through the material. Some properties of Teflon films grafted homogeneously with polystyrene were studied. These films swell only weakly in benzene, even at high styrene content (70%). The weakening point is about 150°C, without melting, and they remain chemically inert. These results have been discussed. (auth)

7826

GRAFT COPOLYMERS FROM NATURAL RUBBER LATEX USING VISIBLE, ULTRAVIOLET, AND γ -RAY INITIATION. W. Cooper, G. Vaughan, S. Miller, and M. Fielden (Dunlop Research Centre, Birmingham, Eng.). *J. Polymer Sci.* **34**, 651-70(1959) Jan.

Graft copolymers were prepared from natural rubber latex and methyl methacrylate using visible, ultraviolet, and γ -radiation. The influence of monomer concentration, temperature, radiation intensity, and in the case of photoinitiation, photosensitizer concentration, on polymerization rates and molecular weight have been studied. The proportion of graft polymer is very high initially but falls with conversion and with increase in monomer concentration. Photoinitiated grafting depends on the photosensitizer and on temperature, but with γ -initiation the fraction grafted is independent of temperature. In the latter case the high proportion of graft cannot be explained in terms of the relative G values and concentrations of monomer and rubber. The fall-off in proportion of graft with conversion is thought to result from microscopic heterogeneous regions formed during polymerization, which are believed to increase in size as polymerization proceeds, thereby reducing further the possibility of grafting. Degradation of previously grafted polymer by prolonged irradiation is not of consequence in this case. Molecular weights of grafted and ungrafted polymers are very similar, except at low monomer concentrations, and a marked feature of this system is their constancy with change in all reaction conditions other than monomer concentration. Estimates of the utilization of radiation energy have been made and it is concluded that on an energy basis γ and photoinitiated reactions are of comparable efficiency. (auth)

7827

γ -IRRADIATION OF RUBBER AND STYRENE. GRAFT POLYMER FORMATION. D. T. Turner (British Rubber Producers' Research Assn., Welwyn Garden City, Herts, Eng.). *J. Polymer Sci.* **35**, 17-29(1959) Feb.

Styrene, styrene mixed with rubber, and rubber alone have been exposed to γ radiation from Co-60. The G value for polymerization-initiating radicals formed from rubber in the mixture, $G(l.r.) = 0.26$, has been calculated from corresponding values obtained by estimation of the number of polystyrene molecules formed in styrene and in the mixture. A G (radical) value for rubber when irradiated alone, $G(r)$, has been assessed from a G (crosslinking) value, $G(X)$, which was determined under closely similar experimental conditions, as $G(r) = 2G(X) \sim 6$. The large discrepancy between $G(r)$ and $G(l.r.)$ cannot be explained satisfactorily on the supposition that radicals formed from rubber have a low efficiency in initiating the polymerization of styrene. Therefore, it is argued that the $G(r)$ value itself is lower in the mixture. Evidence for this argument is

provided by the lower rate of gelling in the mixture. This protection of rubber by energy transfer to styrene is an important example since in only one previous case has experimental evidence been provided to exclude an alternative radical mechanism. By polymerization in the presence of crosslinked rubber, uncombined polystyrene could be readily partitioned into the sol fraction by equilibration of the gross polymer in benzene. About 15% of the polystyrene was free. Hexachloroethane was chosen as an example of an additive with a high G (radical) value. As would be expected, it increases the rate of polymerization but does not lead to a correspondingly large amount of free polystyrene (about 23%). Graft polymer formation from styrene and methyl methacrylate is compared and attention is drawn to the importance of the formation and subsequent reactions of initially nonpolymeric radicals in determining the proportion of free plastomer. (auth)

7028

HIGH-ENERGY RADIATION EFFECTS ON POLYACRYLATES AND POLYMETHACRYLATES. Allan R. Shiltz (Minnesota Mining and Mfg. Co., St. Paul). *J. Polymer Sci.* **35**, 369-80(1959) Mar.

Chemical and physical changes produced in polymethacrylates and polyacrylates by ionizing radiations are examined in the light of data revealing molecular structural changes and ultimate fragmentation products. A 1,4-diradical or concerted mechanism is postulated for polymethacrylate main-chain scission. (auth)

7029

DOSE RATE EFFECT ON CROSSLINKING OF POLYETHYLENE WITH HIGH ENERGY ELECTRONS IN VACUO. G. J. Atchison (Dow Chemical Co., Midland, Mich.). *J. Polymer Sci.* **35**, 557-8(1959) Mar.

The crosslinking produced in a sample of high-pressure polyethylene was measured for electron irradiation in vacuo at dose rates in the range 6 to 2070 megarad/min. (W.L.H.)

7030

A DETERMINATION OF THE URANIUM CONTENT IN THE NATIVE COALS. I. A DIRECT FLUOROMETRIC DETECTION AND SEMIQUANTITATIVE DETERMINATION OF URANIUM IN COAL ASH. Almashahi.

Magyar Tudományos Akad. Kém. Tudományok Osztályának Közleményei **7**, No. 3, 337-43(1956).

(Translated from Referat. *Zhur. Khim.* No. 12, 1958, Abstract No. 39370)

A fluorimetric method for the determination of uranium was used for the analysis of the ash of uranium-containing coals. The procedure can be used for uranium concentrations of not less than 0.001 to 0.005%, and it only takes 10 to 15 minutes. The method used for the semi-quantitative determination is also described. The effect of Fe_2O_3 on the analysis was determined. (J.S.R.)

7031

CHANGES IN THE ELECTRON SPIN RESONANCE SPECTRUM OF GLYCINE WITH INCREASING DOSES OF RADIATION. J. W. Boag and A. Müller (Mount Vernon Hospital, Northwood, Middx., Eng.). *Nature* **183**, 831(1959) Mar. 21.

The results of an investigation of the effects of very high doses of electrons on the electron spin resonance spectrum of glycine and gelatin are reported. (J.H.M.)

7032

ELECTRON SPIN RESONANCE IN IRRADIATED

DESOXYRIBONUCLEIC ACID. J. W. Boag and A. Müller (Mount Vernon Hospital, Northwood, Middx., Eng.). *Nature* **183**, 831-2(1959) Mar. 21.

A study was made of the electron spin resonance spectra of samples of desoxyribonucleic acid irradiated in vacuo, in air, and in nitric oxide. Results indicate that if the samples were dried in vacuo for 24 hr prior to irradiation and were then irradiated either in vacuo or in the presence of dry air or nitric oxide a good electron spin resonance signal was observed in all cases. When moisture was present at the time of irradiation, no electron spin resonance signal was detected. (J.H.M.)

7033

RECENT WORK ON THE SYNTHESIS OF ELEMENT 102. V. I. Goldanskii. *Priroda* **48**, No. 1, 118-21 (1959) Jan. (In Russian)

The Moscow group's scheme for synthesis of element-102 is compared to the experimental scheme carried out by California and Stockholm scientific groups. The α -particle spectra observed in the Moscow experiments are shown. (R.V.J.)

7034

ELECTRON-SPIN RESONANCE STUDIES OF RADIATION DAMAGE TO THE NUCLEIC ACIDS AND THEIR CONSTITUENTS. Howard Shields and Walter Gordy (Duke Univ., Durham, N. C.). *Proc. Natl. Acad. Sci. U. S.* **45**, 269-81(1959) Feb.

Results are reported from electron-spin resonance studies on the effects of ionizing radiations on desoxyribonucleic acid and ribonucleic acid as well as on their constituents and the enzymes which attack them. Electron-spin resonance curves are presented for irradiated thymine, uracil, cytosine, 5-methyl cytosine, d-2-deoxyribose, D-ribose, thymidine, cytidine, uridine, guanosine, adenosine, desoxyguanosine, desoxyadenosine, guanylic acid, cytidylic acid, adenylic acid, uridylic acid, desoxyguanylic acid, desoxycytidylic acid, ribonucleic acid, desoxyribonucleic acid, ribonuclease, and desoxyribonuclease. (C.H.)

7035

COMPETITIVE REACTIONS IN THE IRRADIATION OF ANTHRACENE + CYCLOHEXANE SOLUTIONS.

A. Charlesby and D. G. Lloyd (Royal Military Coll. of Science, Swindon, Eng. and Tube Investments Research Labs., Cambridge, Eng.). *Proc. Roy. Soc. (London)* **A249**, 51-64(1959) Jan. 1.

Anthracene acts as a radical scavenger when present at low concentrations in irradiated hydrocarbons. A study has been made of the effect of radiation intensity and anthracene concentration on $G(-A)$, the number of anthracene molecules lost per 100 ev of energy absorbed. A theoretical calculation is made of the dependence of $G(-A)$ on radiation intensity I and anthracene concentration (A) , assuming that radiation-induced radicals ($R\cdot$) are formed at random, and can either disappear by direct combination with one another, or with the anthracene to give RAR or RAAR bridges, or possibly some form of stabilized RA molecules. This theory is in good agreement with the experimental values of $G(-A)$, measured at various low radiation intensities and anthracene concentrations. From the comparison estimates of the reactivity constants are derived. With very high intensity radiation quantitative agreement is less satisfactory, due to the non-steady conditions prevailing in a pulsed beam. The results obtained are compared with previous work on anthracene +

hexane and iodine + cyclohexane mixtures, in which the effect of radiation intensity was not investigated. The results reported here are of interest to the study of reaction kinetics in irradiated organic systems. (auth)

9836

INDIRECT INACTIVATION OF MACROMOLECULES IN SOLUTION BY IONIZING RADIATION. A METHOD OF ANALYSIS. Leroy Augenstine (Brookhaven National Lab., Upton, N. Y.). *Radiation Research* 10, 89-111(1959) Feb.

The theoretical developments presented provide an improved method of treating indirect inactivation. It is postulated that the probabilities associated with radical destruction and solute inactivation can be measured separately, a predictable behavior is established for the data, the reliability of each of the parameters can be determined, the solvent capability (which includes radical recombinants as well as impurities) can be readily measured and corrected for, the determination of protection coefficients is simplified, and two types of protection can be distinguished. Methylene blue and trypsin have been used as solutes to demonstrate applications of the revised method. The theory and results not only established an improved method of treating indirect inactivation but provide a criterion for discriminating between indirect and other types of inactivation. The criteria provide a means of differentiating mechanisms by which radiation interacts with biological material and of showing how these mechanisms and their associated probabilities are affected by pH and the ionic complement of the solvent. Reanalysis of previously published protein data showed that the linear relation predicted by this method is applicable at the lowest protein concentrations. At high concentrations the yield may—depending on experimental conditions—become larger than expected for indirect inactivation by one kind of radical alone. Such deviations were taken as evidence that either more than one species of radical was producing inactivation or that more likely there was an effect arising from the production of ions in a target volume larger than the protein molecule. (auth)

9837

THE GAMMA RADIOLYSIS OF BUTYL BROMIDES. William S. Wilcox (Southern Research Inst., Birmingham, Ala.). *Radiation Research* 10, 112-17(1959) Feb.

The γ -ray-induced decomposition of the four isomeric butyl bromides was studied. Normal butane is the major product from the two straight-chain compounds, and isobutylene from the two branched-chain isomers. A considerable portion of the bromine corresponding to the production of these hydrocarbons has been found to occur, under the conditions of the experiments, as various dibromobutanes. Isobutyl bromide isomerizes extensively into the tertiary bromide. Some implications of the experimental findings are discussed. (auth)

9838

RADIATION-INDUCED OXIDATION OF AQUEOUS ACETIC ACID—OXYGEN SOLUTIONS. Warren M. Garrison, Herman R. Haymond, Winifred Bennett, and Sibyl Cole (Univ. of California, Berkeley). *Radiation Research* 10, 273-82(1959) Mar.

Radiation-induced oxidation of acetic acid in oxygenated aqueous solution yields glycolic, glyoxylic, and oxalic acids, formaldehyde, and carbon dioxide. For-

mation of these products apparently occurs through parallel processes initiated by formation of a common precursor, viz, the peroxy radicals, O_2CH_2COOH . There is no evidence for a chain reaction. Possible reaction paths for removal of O_2CH_2COOH are treated. The experimental results are shown to be consistent with the concept that the removal steps involve $2RO_2 \rightarrow$ products, $RO_2 + H_2O \rightarrow$ products. A detailed mechanism is presented. (auth)

9839

EVOLUTION OF RADIATION CHEMISTRY. WATER AND AQUEOUS SOLUTIONS. Memoire No. 6. Maria do Carmo Anta. Lisbon, Junta de Energia Nuclear, 1957. 16p. (In French)

After a review of the principal works in radiation chemistry which led to the consideration that the radiolysis of water is an electrolysis without electrodes, the Fricke theory of "activated water" and the present theory on free radicals are discussed. The most recent theories are applied to the interpretation of the mechanism of the oxidation of ferrous sulfate in aqueous solutions. A detailed analysis is made of the utilization of this reaction for chemical dosimetry. (auth)

Separation Processes for Pu and U

9840 CF-59-3-7

Oak Ridge National Lab., Tenn.
POISON ROD REQUIREMENTS FOR A SOLID-FUEL LEACHER TANK. B. E. Prince, Mar. 2, 1959. 10p.
Contract [W-7405-eng-26]. \$1.80(ph), \$1.80(mf) OTS.

Estimates were made of the amount of neutron poisoning, in the form of boron rods, required to maintain subcriticality in a tank used for dissolution of solid fuel elements. The tank under consideration was a cylinder 19.5 inches in diameter and 6 ft in height. Maximum concentrations of fuel and fertile material resulting from dissolution of various type fuel elements are tabulated. Below the maximum concentrations listed, it was found that the limiting poisoning requirements are associated with dissolution of the NS Savannah elements. About five 1-inch diameter rods appear necessary: a centrally located rod and four rods in a square array each about 5 inches from the central rod. (auth)

9841 CRDC-818

Atomic Energy of Canada Ltd., Chalk River, Ont.
THE CHEMISTRY OF THE ANION EXCHANGE PROCESS FOR THE RECOVERY OF PLUTONIUM. R. G. Hart, J. A. Brothers, and I. W. Allam. Dec. 1958. 24p. (AECL-755). \$0.50(AECL).

A semi-theoretical study was made of the chemistry of the Anion Exchange Process for the recovery of plutonium. Pseudo-equilibrium constants were obtained for the systems plutonium(III)—Dowex 50, plutonium(III)—Dowex 50-W, and plutonium(IV)—Dowex 1, in nitric acid solution. Exchange height equations were obtained for the plutonium(III)—Dowex 50 and the plutonium(IV)—Dowex 1 systems. Elution equations are given for the systems plutonium(III)—Dowex 50 and plutonium(III)—Dowex 50-W. The equilibrium plutonium(IV)—Dowex 1 in the presence of uranium is also briefly discussed. (auth)

9842 DP-319

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.

REPROCESSING OF POWER REACTOR FUELS. Third Quarterly Progress Report [for] April 1 to July 1, 1958.

E. S. Occhipinti, comp. Dec. 1958. 15p. Contract AT(07-2)-1. \$0.50(OTS).

Zirconium-clad fuel elements of uranium-molybdenum alloy can be dissolved in boiling hydrofluoric-nitric acid mixtures practicably and without excessive corrosion in a dissolver made of wrought 309 Nb stainless steel; the corrosion of welded seams in these mixtures has not been investigated. Plutonium and uranium can be extracted from the dissolver solution satisfactorily with 10% tributyl phosphate in "Ultrasene" provided that aluminum nitrate is present in the dissolver solution. (For preceding period see DP-318.) (auth)

9843 DP-338

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.

REPROCESSING OF POWER REACTOR FUELS.

Fourth Quarterly Progress Report [for] July 1 to October 1, 1958. Edward S. Occhipinti, comp. Feb. 1959. 12p. Contract AT(07-2)-1. \$0.50(OTS).

Increased concentrations of nitric acid increased the dissolution rate of zirconium in hydrofluoric-nitric acid mixtures having concentrations of hydrofluoric acid less than approximately 1.0 molar. Simulated waste solutions, obtained from the processing of zirconium-clad fuel elements of uranium-molybdenum alloy, could be evaporated to one-half their original volume without the formation of undesirable amounts of precipitate. The dissolution rate of stainless steel by electrolysis in nitric acid was primarily a function of the current density; variations in the acidity, salt concentration, and temperature were ineffective over wide ranges. (For preceding period see DP-319.) (auth)

9844 HW-33374(Del.)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

EFFECTS OF SOLUTION COMPOSITION ON THE CORROSION OF THE REDOX H-4 OXIDIZER.

Norman D. Groves, Morris C. Fraser, and William L. Walker. Aug. 18, 1955. Decl. with deletions Feb. 4, 1959. 19p. Contract [W-31-109-Eng-52].

Two series of tests were completed which were designed to evaluate the corrosion problem present in the Redox H-4 Oxidizer. The first series of tests involved exposing annealed coupons of Types 304L and 309SCb stainless steel to nine synthetic H-4 Oxidizer solutions. The solutions all contained UNH and had varying amounts of several oxidizing agents. The free nitric acid of the solutions ranged from 0.2 M acid to -0.2 M acid deficient. These exposures were all made at the boiling point of the respective solution and had an exposure time of five 48-hour periods. The second series of tests consisted of exposing sensitized specimens of Types 304L, 312, and 347 stainless steels under static conditions at the boiling point of three synthetic H-4 Oxidizer solutions and as heat transfer surfaces at temperatures of 140°C. The three solutions used contained UNH, 0.15 M sodium dichromate and either 0.2 M, 0.01 M, or -0.2 M nitric acid. The test duration was 336 hours. A-55 titanium in the as-received condition was exposed in the manner described above. (auth)

9845 HW-59301

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

RANDOM LOADING OF E-METAL DISSOLVER.

N. Kotelach. Feb. 25, 1959. 28p. Contract W-31-109-Eng-52. \$4.80(ph), \$2.70(mf) OTS.

Nuclear safety in the dissolution of irradiated 0.95%

U^{235} enriched fuel was investigated. Critical conditions of fuel of this enrichment in a 52-in.-diam. dissolver crib were studied. The processing of I and E fuel elements in a 52-in.-diam. dissolver crib can be based on random loading of the dissolver. The maximum safe dissolver charge depends on the assumptions that can be made regarding the distribution of fuel in the dissolver. It depends on whether the fuel can be loaded into a cylindrical pile whose diameter is less than 52-in.-diam. dissolver crib. The dissolver limits calculated require complete dissolution before a new dissolver charge is added. (W.L.H.)

9846 ORNL-2461

Oak Ridge National Lab., Tenn.

DEVELOPMENT OF THE SULFEX PROCESS FOR DECLADDING STAINLESS-STEEL-CLAD POWER REACTOR FUEL ELEMENTS WITH SULFURIC ACID.

J. R. Flanary, W. E. Clark, J. H. Goode, and A. H. Kibbey. Mar. 30, 1959. 29p. Contract W-7405-eng-26. \$1.00(OTS).

A flowsheet, based on laboratory studies, was designed for processing the fuel proposed for the Yankee Atomic Power Reactor by the Sulfex process. This process consists of selective dissolution of the stainless steel cladding by sulfuric acid, with subsequent dissolution of the exposed UO_2 core in nitric acid. With appropriate modifications, the process should be applicable to other stainless steel-clad reactor fuels. With unirradiated fuel specimens, dissolution of type 304L stainless steel cladding proceeded at rates of 2-5 mg/cm²/min in boiling 4 M H_2SO_4 ; the rate appeared somewhat lower with irradiated specimens. From 0.01 to 0.02% of the uranium was lost to the decladding solution. The spent decladding solution may be neutralized with lime to form a plasterlike solid waste; open-pit disposal of this waste appears feasible. Subsequent dissolution of the UO_2 core proceeded readily in nitric acid, yielding a concentrated uranyl nitrate solution which may be readily processed in existing Purex solvent extraction facilities. (auth)

9847 AEC-tr-3598

EXTRACTION OF URANIUM IN THE FORM OF

ANILINE URANYL TRIACETATE. V. M. Vdovenko and L. N. Lazarev. Translated by A. L. Monks (Oak Ridge National Lab.) from *Zhur. Neorg. Khim.* **3**, 155-9(1958). 12p. (Includes original, 5p.) \$3.30(ph), \$2.40(mf) JCL or LC.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 17041.

9848

MINING AND PROCESSING AT THE MARY KATHLEEN. *Atomic World* **10**, 98-8(1959) Mar.

Ore mining and processing to the yellow cake at Mary Kathleen, Queensland, Australia, are described. The mining, crushing, grinding, leaching, solids separation, ion exchange, purification, and final precipitation procedures and equipment are discussed in some detail. (T.R.H.)

9849

PROCESSING CONCENTRATE TO URANIUM METAL. *Atomic World* **10**, 99-100(1959) Mar.

Processing yellow cake from the Commonwealth to pure U metal at the Springfield factory of the UKAEA is briefly described. (T.R.H.)

9850

CONVERSION OF URANIUM TRIOXIDE TO URANIUM HEXAFLUORIDE IN THREE-STEP PROCESS. C. S.

Cronan (Union Carbide Nuclear Co., Paducah, Ky.).
Chem. Eng. 66, No. 6, 140-3(1959) Mar. 23.

The UO_2 conversion plant at Paducah, Ky., is described. The three reaction steps, H_2 -reduction to UO_2 , hydrofluorination to UF_4 , and fluorination to UF_6 , are extremely exothermic requiring close control. Other unique features and equipment of the plant are described. (T.R.H.)

9851

EXTRACTION OF PENTAVALENT NEPTUNIUM. I. P. Alimarin, Yu. A. Zolotov, and E. S. Pal'shin (Vernadsky Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). *Doklady Akad. Nauk S.S.S.R.* 124, 328-30(1959) Jan. 11. (In Russian)

Separation of pentavalent neptunium by solvent extraction with 1-nitroso-2-naphthol in *n*-butyl alcohol and isoamyl alcohol at pH 9 to 10 is described. The activity was measured with the ordinary end-window counter with $\pm 5\%$ precision. The data obtained can be used in neptunium separation from plutonium and uranium. (R.V.J.)

9852

THE CO-EXTRACTION OF NITRIC ACID AND URANYL NITRATE BY TRIBUTYL PHOSPHATE. Taichi Sato (Government Chemical Industrial Research Inst., Tokyo). *J. Inorg. & Nuclear Chem.* 9, 188-90(1959) Feb.

The most satisfactory method for the determination of nitric acid in the presence of uranyl nitrate was the sodium oxalate complexing of uranium. The determination of nitric acid in the organic phase was carried out by back extraction into a constant volume of water, addition of 2% sodium oxalate solution to the aqueous backwash, and titration with 0.5N sodium hydroxide using phenolphthalein as indicator. The value obtained was corrected by comparison with a blank. (J.E.D.)

9853

SPRINGFIELDS, UKAEA URANIUM FUEL FACTORY. *Nuclear Energy Eng.* 146-9(1959) Mar.

A brief description with pictures is given of the UKAEA uranium fuel factory at Springfield. (T.R.H.)

9854

SEPARATION OF PLUTONIUM. (To U. K. Atomic Energy Authority (U.S.A.).) British Patent 798,685. *Nuclear Eng.* 4, 146(1959) Mar.

Extraction of plutonium from irradiated uranium dissolved in nitric acid, in which the plutonium is present in extremely low concentration, is effected by precipitating the plutonium as a phosphate with bismuth phosphate as carrier.

CONTROLLED THERMONUCLEAR PROCESSES

9855

CF-59-2-75

Oak Ridge National Lab., Tenn.

BOUNDARY CONDITIONS AND CONSERVATION PROPERTIES OF FOPP, A PLASMA FOKKER-PLANCK CODE. T. K. Fowler, F. M. Rankin, and A. Simon. Feb. 27, 1959. 15p. Contract [W-7405-eng-26]. \$3.30(ph), \$2.40(mf) OTS.

The energy distributions of ions and electrons in DCX are being studied by means of the Fokker-Planck approximation to the Boltzmann equation. An IBM-704

code, called FOPP, was constructed to solve simultaneously the coupled Fokker-Planck equations for each of the two species of particles. This report discusses the difference scheme employed and derives the boundary conditions necessary in order that this difference scheme conserve energy and particles in the absence of sources and sinks. In particular, detailed discussion is given of problems arising from the use of two grid sizes, which proved advantageous on account of the great difference in the mass of ions and electrons. (auth)

9856 NYO-3722

Princeton Univ., N. J. Project Matterhorn. MAINTENANCE OF A CONSTANT AXIAL MAGNETIC FIELD IN AN INTERRUPTED SOLENOID BY MEANS OF RECTANGULAR CURRENT SHEETS. Technical Memorandum No. 9. William A. Newcomb. Oct. 1, 1953. 19p. \$3.30(ph), \$2.40(mf) OTS.

A magnetic field is maintained along the axis of an infinitely long glass tube of radius b by means of a coil with inner and outer radii equal to a_1 and a_2 , respectively. There are no windings between $x = -b$ and $x = b$ because the tube is joined to a cross-piece of radius b . In order to maintain a constant field within the gap, Helmholtz coils might be placed on both sides of the cross-piece. An alternative procedure would be to provide rectangular current sheets parallel to the Z -axis on both sides of the cross-piece. The current sheet method has a serious disadvantage since the field of the current sheets has no Z -component. The off-axis field thus will be badly distorted even though the field is kept uniform along the axis. As a result, the lines of force in the x - z plane will strike the wall and be lost. The maintenance of a uniform field along the axis, the magnetic energy stored in the current sheets, and the off-axis distortion are examined. (A.C.)

9857 NYO-6369

Princeton Univ., N. J. Project Matterhorn. INDUCTIVE ENERGY STORAGE FOR CONFINING FIELD. Technical Memorandum No. 24. R. G. Mills. April 20, 1956. Decl. Nov. 15, 1958. 12p. \$3.30(ph), \$2.40(mf) OTS.

A proposal is made for extending Matterhorn's present energy storage facilities in a manner which would be significantly cheaper than purchasing additional capacitors, have a longer capacitor lifetime, be more versatile, and allow inexpensive additional energy storage at a later date. (auth)

9858 NYO-7876

Princeton Univ., N. J. Project Matterhorn. ANALOG CONDUCTIVITY COMPUTER—ES-173. Technical Memorandum No. 34. Mark A. Heald. Oct. 1956. 6p. \$1.80(ph), \$1.80(mf) OTS.

A conductivity computer is described. The computer consists of an electronic analog dividing circuit which reads out a signal proportional to the logarithm of a conductance corresponding to input voltage and current signal voltages. (A.C.)

9859 NYO-7881

[Princeton Univ., N. J. Project Matterhorn.] BEHAVIOR OF THE MAGNETIC LINES OF FORCE IN THE MAGNETIC PUMPING SECTION OF THE B-2 STELLARATOR. Technical Memorandum No. 39. Kenneth E. Wakefield. Dec. 3, 1956. 10p. Contract AT(30-1)-1238. \$1.80(ph), \$1.80(mf) OTS.

Results are summarized from a study of the B-2 magnetic pumping section, commonly called the B-2 Bulge,

using the axially symmetric resistance analogue. The limiting aperture is found for all values of M , the pumping modulus, from zero to 1.00, taken in steps of 0.05. The radius of the limiting flux line is given for seven axially spaced points within the bulge. This radius was found for the instants in time when the R-F current is peak negative, peak positive, and zero. The location of the limiting flux line for $M = 0.85$ was determined as a function of time. For comparison, the time-dependent location of the flux line having one-fourth the value of the limiting flux line is also shown, again for $M = 0.85$. Empirical formulas are given enabling a determination of the value of the flux line at any radius (at any of the seven axial positions) for any instant of time and any value of M . Conversely, through a process of iteration, the formulas may be used to find the radius of a given flux line, again for any instant of time and value of M . (auth)

9860 NYO-7892

Princeton Univ., N. J. Project Matterhorn. EFFECT OF SCRAPE-OFF IN SYSTEMS CONTAINING HELICAL STABILIZING WINDINGS. Technical Memorandum No. 45. Kenneth E. Wakefield. May 14, 1957. Decl. Nov. 15, 1958. 10p. \$1.80(ph), \$1.80 (mf) OTS.

In a practical system, the scrape-off distance (the distance between the magnetic surface at the plasma boundary and the smallest magnetic surface leading into or tangent to the tube) cannot be reduced below a critical minimum, which is usually several times the radius of gyration of the positive ions. Assuming that the transverse field for an $l = 3$ system is proportional to the square of the radius, and neglecting the effect of the helical windings on the axial field, one is able to determine the locations of the magnetic surfaces in terms of the magnitudes of the magnetic fields, the aperture radius, and the pitch of the conductors. (W.D.M.)

9861 ORNL-2354

Oak Ridge National Lab., Tenn. SOME PROPERTIES OF A STEADY STATE HIGH-ENERGY INJECTION DEVICE (DCX). A. Simon and M. Rankin. Sept. 5, 1957. Decl. Nov. 7, 1958. 42p. Contract W-7405-eng-26. \$6.30(ph), \$3.00(mf) OTS.

DCX is an experimental Sherwood device utilizing high-energy molecular ion injection and trapping. It is shown that, if the input current of trapped deuterons exceeds a critical amount, there will occur a "burnout" of most of the neutral particles in the system. If this burnout does occur, the input ions will degrade only slightly in energy before becoming disorganized in direction and forming a plasma. Some possible perturbing mechanisms are considered. Impurities are shown to have little effect on the temperature, although their presence decreases the plasma density somewhat. Heat conduction to the walls and to the arc is estimated as well as the effect of cold electrons. It appears that in the absence of plasma instabilities, the final temperature, assuming an input energy of 300 kev, can be as high as 280 kev or as low as 75 kev. A plasma density of 10^{12} or greater may be achievable with a 1 ma input. (auth)

7862

CONDUCTIVITY OF PLASMAS TO MICROWAVES.

P. H. Fang (National Bureau of Standards, Washington). *Phys. Rev.* **113**, 13-14(1959) Jan. 1.

Plasma conductivities for electrons with a Maxwellian energy distribution are evaluated for the cases in which

the collision cross section is (i) velocity independent and (ii) inversely proportional to the velocity. The corresponding distribution functions of relaxation times are discussed. (auth)

9863

TRAJECTORY-WISE ANALYSIS OF CYLINDRICAL AND PLANE PLASMAS IN A MAGNETIC FIELD AND WITHOUT COLLISIONS. Lewi Tonks (Univ. of California, Livermore). *Phys. Rev.* **113**, 400-7(1959) Jan. 15.

The anatomy of the transition region between vacuum and a fully developed magnetically immobilized ionized-gas plasma was examined by following particle trajectories in detail. The mathematical formulation required machine computation for its full interpretation. This approach recognizes the structure imparted to the plasma by the radius of gyration and thus serves as a critique of the magnetohydrodynamic method. It furnishes the microscopic verification of that macroscopic approach and supplements it by showing that the sharpness of transitions in a plasma are limited, in effect, by the gyration radius in the stronger, not the weaker, magnetic field. Especially, it brings out the greater importance of the tensor character of the plasma pressure in the cylindrical case where the combined kinetic and magnetic energy density in uniform interior regions of the plasma is not equal to the magnetic energy density in the vacuum. The analysis also exhibits the intense mass motion at the surface of a strong plasma constituting a paramagnetic electric current and probably having dynamical effects. The numerical work was correlated where possible with direct theoretical results. (auth)

9864

ELECTRON ENERGY DISTRIBUTIONS IN PLASMAS. I. R. L. F. Boyd and N. D. Twiddy (University Coll., London). *Proc. Roy. Soc. (London)* **A250**, 53-69(1959) Feb. 24.

A method is presented of carrying out a Druyvesteyn analysis electronically, and a critical account of its performance is given. A high-frequency voltage of small amplitude chopped with a certain lower frequency is applied to a spherical probe, and the second derivative of the current-voltage characteristic is found from the amplitude of the sine wave with the chopping frequency present in the probe current. An adequate signal-to-noise ratio is obtained by using narrow band amplification with phase-sensitive detection. A large amount of data has now been obtained with this method in a variety of striated discharges. It is found that in every case studied so far the energy distribution takes the form of two well-separated groups of electrons with sometimes a very small third group. The high-energy group is generated by the potential difference across the striation head and becomes progressively attenuated towards its tail. An effect of the varying distribution is a sudden increase in the net rate of loss of electrons from the low-energy group resulting from the fall in number of electrons capable of ionizing and the change in potential difference between wall and discharge at the end of the striation. This loss of electrons causes a fall in the local discharge conductivity and so gives rise to another potential step and striation head. (auth)

7865

CONTROL OF THERMONUCLEAR PROCESSES.

E. I. Dobrokhotov. *Priroda* **48**, No. 1, 103-8(1959) Jan. (In Russian)

Reports and discussions on the problems of controlled thermonuclear processes presented at the second Geneva Conference are surveyed. Descriptions are given of the Princeton Stellarator B-3, English "Zeta", Soviet Ionic Magnetron, and the recently constructed "Ogr", a large entrainment separator with magnetic plugs. (R.V.J.)

GEOLOGY AND MINERALOGY

9866

THE DETERMINATION OF THE AGE OF MINERALS AND ROCKS WITH THE AID OF RADIOGENIC MINERALS. René Perrin and Marcel Roubault. Compt. rend. **248**, 881-3(1959) Feb. 16. (In French)

The variations in the age determinations of minerals are discussed, with the use of zircon as an example. It is concluded that the differences can be attributed to the fact that during the formation of zircons, the uranium alone is incorporated in the lattice to the exclusion of lead. (J.S.R.)

9867

THE CRYSTAL STRUCTURE OF SKLODOWSKITE. V. I. Mokeeva (Vernadskii Inst. of Geochemistry and Analytical Chemistry). Doklady Akad. Nauk S.S.S.R. **124**, 578-80(1959) Jan. 21. (In Russian)

A specimen of $0.05 \times 0.07 \times 0.4$ mm prepared sklodowskite crystal was studied. The Laurie oscillation-rotation x-ray-diffraction studies showed that the crystal is monoclinic and the parameters of the volume centered elementary cell are $a = 16.74$, $b = 7.01A$, $c = 6.59A$, and $\beta = 96^\circ$, which are in good agreement with published data. The sklodowskite formula according to the suggested structure is $MgU_2O_2(OH)_2(SiO_4)_2 \cdot 4H_2O$. (R.V.J.)

9869

GEOLOGY OF THE URANIUM DEPOSITS IN THE COCHETOPA MINING DISTRICT, SAGUACHE AND GUNNISON COUNTIES, COLORADO. Roger C. Malan and Henry W. Ranspot. Econ. Geol. **54**, 1-19(1959) Jan.-Feb.

Vein-type uranium deposits of geologic interest and commercial significance occur in the Cochetopa mining district, Saguache and Gunnison Counties, Colorado. The uranium minerals in these deposits have been precipitated from hypogene solutions probably related to Tertiary igneous activity in the district. Silicification and brecciation of the sedimentary rocks in the Morrison formation and the Dakota sandstone, in and adjacent to fault zones, controlled deposition of uranium minerals from hydrothermal solutions. The most important deposits in the district are at the Gunnison Mining Company's Los Ochos claims where substantial reserves of ore in pipelike and in vertically tabular bodies have been blocked out. Pitchblende, the dominant uranium mineral, is associated with abundant clay and minor amounts of marcasite. As a result of studies carried out in the district, certain pertinent geologic criteria on ore localizing influences have been established. (auth)

9869

THE NATURE OF DAVIDITE. Alick W. G. Whittle (S. A. Government Dept. of Mines, Adelaide). Econ. Geol. **54**, 64-81(1959) Jan.-Feb.

The Precambrian rocks of Australia contain a wider variety of davidites than has been found else-

where in the world. Investigation of davidite occurrences as an economic uranium ore over a number of years has revealed its many peculiar physical and chemical characteristics. It has been shown to be a primary mineral generally associated with sodium-rich acidic igneous rock as replacement lode deposits, as disseminated replacement deposits, as fissure fillings of pneumatolytic origin and as an accessory mineral in pegmatites. Its association with titania, both as regular and recognizable inclusions of rutile and ilmenite, and as the less apparent sub-microscopic titaniferous "framework," raises the question as to whether the generally accepted description and composition of davidite is valid. (auth)

9870

SOME GEOCHEMICAL CONSIDERATIONS ON LEAD-ISOTOPE DATING OF LEAD DEPOSITS. R. W. Boyle (Geological Survey of Canada, Ottawa). Econ. Geol. **54**, 130-5(1959) Jan.-Feb.

The validity of age determinations based on the lead-isotope ratios of galena or other lead minerals in deposits is questioned. A few simple examples are given to show that fractionation of lead isotopes in geochemical processes is probable. The geochemical processes through which lead has passed must be considered in detail before an age can be assigned to a lead deposit. (auth)

9871

LEAD ISOTOPES FROM BALMAT AREA, NEW YORK. John S. Brown and J. Laurence Kulp (St. Joseph Lead Co., Bonne Terre, Mo. and Columbia Univ., New York). Econ. Geol. **54**, 137-9(1959) Jan.-Feb.

The isotopic composition of the lead minerals from the Balmat Area was determined by standard mass spectrographic methods. The results and sample descriptions are tabulated. The isotopic composition indicates a Precambrian age. According to the latest estimate of lead isotope evaluation in the earth's crust using the basic Houtermanns-Holmes model, the age of deposition is 1050 ± 100 million years. (J.E.D.)

9872

A CONTENT OF DEUTERIUM IN SAMPLES OF WATER TAKEN FROM OIL FIELDS. Fodor-Chan'í Tsike. Ridrol. Közlöny **37**, 245-8(1957). (Translated from Referat. Zhur. Khim. No. 12, 1958, Abstract No. 39274.)

From the analysis of thirty-one samples, a study was made of the relationship between D content and the depth, the geological age, the amount of the dry residue, and the presence of certain ions. The amount of D is increased with an increase in the depth, and is similar in water samples from the same geological age. However, the sequence of geological periods is not related to the D_2O content. In all of the samples, except two, no radioactivity deviating from the background value was revealed. The relationship between D content and the amount of the dry residue indicates a marine origin of waters having a high amount of dry residue. The content of chlorides is increased and that of CO_3^{2-} and HCO_3^- is decreased with the increase of D_2O .

9873

C^{14} AGE DETERMINATION OF GROUND WATER. R. Brinkmann (Univ. of Bonn) and K. O. Münnich and J. C. Vogel (Univ. of Heidelberg, Ger.). Naturwissenschaften **46**, 10-12(1959). (In German)

Water samples from various deep-lying springs were investigated to determine how far an age determination of these waters from C^{14} content is possible. The results, which are tabulated, show a decreasing C^{14} content of the water with increasing depth. The disturbing effects which could cause a decreased C^{14} content and, therefore, give a high age for the water are discussed. It was estimated that the ages obtained were about 1500 years too high. (J.S.R.)

9574

PRELIMINARY STUDY OF RADIOACTIVE LIMONITE IN COLORADO, UTAH, AND WYOMING. T. G. Lovering and E. P. Beroni. *U. S. Geol. Survey Bull.* 1046-N. 1959. 49p. \$0.35.

Nine radioactive-limonite localities of different types were sampled during the spring and fall of 1953 in an effort to establish criteria for differentiating limonite outcrops associated with uranium or thorium deposits from limonite outcrops not associated with such deposits. The samples were analyzed for uranium and thorium by standard chemical methods, for equivalent uranium by the radiometric method, and for a number of common metals by semiquantitative geochemical methods. Correlation coefficients were then calculated for each of the metals with respect to equivalent uranium, and to uranium, where present, for all the samples from each locality. The correlation coefficients may indicate a significant association between uranium or thorium and certain other metals. Occurrences of specific metals that are interpreted as significant vary considerably for different uranium localities but are more consistent for the thorium localities. Samples taken from radioactive outcrops in the vicinity of uranium or thorium deposits can be quickly analyzed by geochemical methods for various elements. Correlation coefficients can then be determined for the various elements with respect to uranium or thorium; if any significant correlations are obtained, the elements showing such correlation may be used as indicators of uranium or thorium elsewhere in the area. Soil samples of covered areas in the vicinity of the radioactive outcrop may then be analyzed for the indicator elements and any resulting anomalies used as a guide for prospecting where the depth of overburden is too great to allow the use of radiation-detecting instruments. Changes in color of limonite stains on the outcrop may also be a useful guide to ore in some areas. Correlation coefficients of the associated indicator elements, used in conjunction with petrographic evidence, may be useful, too, in interpreting the origin and paragenesis of radioactive deposits. (auth)

9575

RECONNAISSANCE FOR RADIOACTIVITY IN THE METAL-MINING DISTRICTS OF THE SAN JUAN MOUNTAINS, COLORADO. C. T. Pierson, W. F. Weeks, and F. J. Kleinhampl. *U. S. Geol. Survey Bull.* 1046-O. 33p. and 2 illus.

Thirty-four metal-mining districts in the San Juan Mountains, Colo., were investigated during 1951-53 in a reconnaissance for radioactive materials. No commercial uranium deposit was found during the reconnaissance, but one deposit has since been discovered and developed in the Cochetopa area by private interests. Except for the Cochetopa deposit, all the known occurrences of uranium minerals are small or of low grade. Additional prospecting, however, might result in the discovery of small ore deposits of

uranium, or of ores of other metals that contain sufficient uranium to be produced as a byproduct. Samples collected from the Bonanza, Upper Uncompahgre, La Plata, and Red Mountain districts contain 2.71, 0.53, 0.40, and 0.35 percent of uranium, respectively; samples from the Telluride, Lower Uncompahgre, Rico, Engineer Mountain, Burrows Park (Whitcross), Carson Camp, and Creede districts contain smaller though significant amounts of uranium. Radioactivity caused by thorium is known in the Cebolla-Powderhorn district and in the Burrows Park (Whitcross) district. Radon was largely responsible for the radioactivity measured in the Mount Wilson district. In the Bonanza district, pitchblende was found on the dump of the caved Whale adit, where it is associated with pyrite, galena, chalcocopyrite, tetrahedrite, and enargite as fracture coatings in silicified andesite of Tertiary age. In the Upper Uncompahgre district, pitchblende was found in the Michael Breen mine in a narrow vein in the San Juan tuff of Tertiary age and near Bear Creek Falls south of Ouray in a shear zone in the slate of the Precambrian Uncompahgre formation. In the La Plata district, small amounts of uranium are contained in limonite in altered Tertiary diorite from a surface trench on the Tomahawk vein. In the Red Mountain district, pitchblende occurs in the pyritic silver-bearing galena sphalerite-chalcocopyrite-enargite ores from several chimney and vein deposits of Tertiary age. In the Telluride district a uranium-bearing hydrocarbon is found in pyritic and siliceous galena-sphalerite ore from the footwall of the Montana vein in the San Juan tuff of Tertiary age. The small amounts of uranium in the other districts occur with base-metal sulfide ores from several geologic environments. (auth)

9576

MINERALOGY AND GEOLOGY OF RADIOACTIVE RAW MATERIALS. E. Wm. Heinrich. New York, McGraw-Hill Book Company, Inc., 1958. 562p.

Part I includes a general review of the structure and properties of radioactive minerals and describes the uranium and thorium minerals, related radioactive hydrocarbon complexes, minerals with minor U, Th, or Ra, and those with radioactive impurities. Part II describes the syngenetic deposits in igneous rocks, radioactive pegmatites, carbonatites, and related deposits, pyrometamorphic and other high-intensity hydrothermal deposits, mesothermal and epithermal deposits, epigenetic stratiform deposits in sedimentary rocks, uraniferous phosphorites, uraniferous marine black shales, radioactive hydrocarbons, placer deposits of radioactive minerals, and deposits formed by weathering and ground-water action. (J.E.D.)

9577

RADIATION DAMAGE AS A RESEARCH TOOL FOR GEOLOGY AND PREHISTORY. N. Grögler, F. G. Houtermans, and H. Stauffer (Univ. of Berne). p. 3-15 in "Suppl. to 5th International Electronic and Nuclear Review. Acta of the Scientific Congress, June 16-20, 1958. Volume I. Nuclear Section."

Possible applications of radiation damage to problems of geology and prehistory are discussed and some examples of previous work are given. It is shown, that not only strong effects of radiation damage, as metamictisation, variation of lattice constants and production of color centers, but also the rather weak effects of creation and excitation of electron traps may give much information about the radiation, thermal, and pressure

history of natural minerals and rocks as well as of meteorites. A more detailed discussion of thermoluminescence measurements on meteorites is given. Furthermore the application of thermoluminescence to problems of heating processes in sedimentary layers and to dating of ancient pottery are shown. (auth)

7876

THE COMPOSITION OF A COMPLEX ORE OF MOZAMBIQUE, PORTUGUESE EAST AFRICA. Memoire No. 9. A. Herculano de Carvalho and J. Duarte de Almeida. Lisbon, Junta de Energia Nuclear, 1957. 8p. (In French)

Some samples of a complex ore from Mozambique, named "mavuzite," were analyzed, and the results were compared with those obtained by Bannister and Horne (*Mineral. Mag.* 29, 101(1950)). Details of the techniques used are discussed, particularly the dissolution of the uranium. The uranium was dissolved by hot acid leaching. (auth)

HEALTH AND SAFETY

9879 AECU-4017

National Sanitation Foundation, Ann Arbor, Mich. COLLECTION AND ANALYSIS OF RADIOACTIVE MATERIAL FROM SIBLEY QUARRY. Walter F. Snyder and John V. Nehemias. Dec. 29, 1958. 19p. For Detroit Edison Co. \$3.30(ph), \$2.40(mf) OTS.

Samples of various media were collected at several points in southwestern Michigan, Ohio, and Ontario during 1958 and analyzed for radioactivity as part of a general pre-operational radiological survey of the environment of the Enrico Fermi Nuclear Power Reactor. Media sampled included earth, dust, rain, surface water, underground water, surface sediment, benthos, fish, vegetation, and mammals. Data provide an indication of the existing levels of radioactivity present in environmental media in the area under study and their variations with time and location. It is apparent from the nature of the radioactivity found, as well as from the distribution, that the material originated at nuclear test detonations in the Pacific and certain other remote areas. Samples were collected from Sibley Quarry after readings notably higher than background were reported. Sampling procedures and laboratory procedures used in an evaluation of these samples are outlined. Data are tabulated. Results are compared with radioactivity found in similar samples collected in the area. The separation of radionuclides by elements provides convincing evidence that the observed radioactivity is due to fission products from detonations occurring a few days to a few months prior to October 10, 1958. (C.H.)

9880 AECU-4025

Northwestern Univ., Evanston, Ill. Technological Inst. AN INVESTIGATION OF THE FATE OF FISSION PRODUCTS IN THE ILLINOIS WATERWAY SYSTEM. I. E. Thomas, W. S. Hamilton, and C. G. Bell. Jan. 1, 1959. 52p. Contract T(11-1)-353. \$9.30(ph), \$3.60(mf) OTS.

The project was principally directed towards a consideration of the fate of nuclear fission products if such products were discharged into the Illinois River System. The investigation included theoretical work on flow dispersion and the performance and analysis of field experiments on radionuclide dispersion. The main dispersion experiments were conducted in the Chicago Sanitary and Ship Canal, with preliminary experiments

being run in Prairie Creek, a small stream located in the Joliet Arsenal area. The radionuclides used were Y^{90} , Ce^{144} , Cs^{137} , and tritium water. (W.L.H.)

9881 BNL-436

[Brookhaven National Lab., Upton, N. Y.]. FALLOUT STUDIES AT BNL DURING THE SUMMER OF 1956. J. Weiss and F. P. Cowan. 22p. \$4.80(ph), \$2.70(mf) OTS.

Results are reported from a study of the characteristics of surfaces in regard to fall-out contamination and decontamination. The surfaces of interest were those used commonly for buildings, roads, and sidewalks. Panels of building materials were exposed during the Pacific weapons tests in the summer of 1956. The panels were surveyed after each period of rain. If there was no rain, the panels were surveyed three times a week. Samples of rainwater were also collected for analysis. The samples were processed, using standard analytical procedures, and were analyzed for total activity and levels of molybdenum-99, iodine-131, zirconium-95, and strontium-90. The effects of a bath with clear water or detergent were measured. Data are presented graphically, and results are discussed. Activity of the specific isotopes followed no regular pattern, either on a concentration basis or a total activity basis. It was concluded that when the volume of rain is small, the concentration of gross activity is high, and when the volume is large, the concentration is low. The amount of activity which comes down in rain is roughly proportional to the amount of rain that falls. (C.H.)

9882 CF-53-3-173

Oak Ridge National Lab., Tenn. ANALYSIS OF "FALL-OUT" ACTIVITY AT ORNL. S. A. Reynolds. Mar. 20, 1953. Decl. Feb. 12, 1959. 3p. Contract [W-7405-eng-26]. \$1.80(ph), \$1.80(mf) OTS.

The fall-out activity at ORNL resulting from a bomb test in March 1953 was analyzed. Radiochemical separations, decay studies, beta absorption data, and gamma spectra were used in the identification. "Smears" were studied directly by beta absorption, decay, and gamma spectroscopy, while the filter papers were leached with HCl or HNO_3 for radiochemical analysis. The apparent half life was determined as 2 days. No alpha activity was found in any of the samples tested. (W.D.M.)

9883 CF-53-7-239

Oak Ridge National Lab., Tenn. ATOMIC WEAPONS TEST FALL-OUT AT ORNL ON MARCH 19, 1953. R. L. Bradshaw and W. D. Cottrell. July 21, 1953. 14p. Contract [W-7405-eng-26]. \$3.30(ph), \$2.40(mf) OTS.

On the evening of March 18, 1953, widespread contamination was found to exist on the laboratory. Five radioactive particles from various locations were isolated and examined as to size, appearance, and activity. These data along the photomicrographs are presented. All the particles examined were spherical in shape (18 to 24 microns in diam.) and had the appearance of having been formed from molten material. (W.D.M.)

9884 CRCE-808

Atomic Energy of Canada Ltd., Chalk River, Ont. INITIATION OF A FIELD BURIAL TEST OF THE DISPOSAL OF FISSION PRODUCTS INCORPORATED INTO GLASS. A. R. Bancroft and J. D. Gamble. Nov. 1958. 16p. (AECL-718). \$0.50(AECL).

A test has been started to measure the dispersal of

radioactivity from glass containing fission products when buried in wet ground. This test should also permit a comparison of the leaching rates obtained in the laboratory with those obtained in the field, and should demonstrate the degree of reliability with which laboratory results may be extrapolated. The preparation, preliminary leaching, and burial in wet ground of more than 300 curies of mixed fission products in the form of 25 glass blocks weighing 2 kg each are described. No measurements of the radioactivity in the ground water are given. The results of such measurements and their interpretation will be the subject of a future report, after a significant amount of data has been obtained. Measurements made in the laboratory indicate that the leaching rate of this glass decreased during the first three weeks of submersion in distilled water by a factor of 500 to a level of 1.0×10^{-7} g/cm²-day. After this period the leaching rate decreased at a slower rate. (auth)

9885 HASL-1

New York Operations Office. Health and Safety Lab., AEC.

STRONTIUM PROGRAM. Summary Report for October 1957. Edward P. Hardy, Jr. 80p. \$12.30(ph), \$4.50 (mf) OTS.

Strontium-90 levels in fall-out, milk, canned fish, and tap water are summarized for data available up to Sept. 15, 1957. (W.D.M.)

9886 HASL-8

New York Operations Office. Health and Safety Lab., AEC.

STRONTIUM PROGRAM. Summary Report for December 1957. Edward P. Hardy, Jr. 61p. \$10.50(ph), \$3.90(mf) OTS.

Strontium-90 levels in fall-out for New York City, Pittsburgh, Chicago, other U. S. sites, and selected sites throughout the world, in milk (powdered and liquid) from various sites, in canned fish, and in New York City tap water are summarized for data available up to Nov. 30, 1957. (W.D.M.)

9887 HASL-23

New York Operations Office. Health and Safety Lab., AEC.

STRONTIUM PROGRAM. Summary Report for February 1958. Edward P. Hardy, Jr. Changed from OFFICIAL USE ONLY Apr. 16, 1959. 58p. \$9.30(ph), \$3.60(mf) OTS.

Strontium-90 levels in fall-out for New York City, Pittsburgh, Chicago, other U. S. sites, and monitoring sites outside continental U. S., in milk from Perry and New York City, New York, and in New York City tap water are summarized for data available up to January 30, 1958. (W.D.M.)

9888 HASL-34

New York Operations Office. Health and Safety Lab., AEC.

STRONTIUM PROGRAM. Summary Report for April 1958. Edward P. Hardy, Jr. Apr. 15, 1958. 55p. \$9.30(ph), \$3.60(mf) OTS.

Strontium-90 levels in fall-out for New York City, Pittsburgh, Chicago, Westwood, N. J., and other U. S. monitoring sites, in milk from New York, and in New York City tap water are summarized for data up to April 5, 1958. (W.D.M.)

9889 HW-7865

[Hanford Works, Richland, Wash.].

PRELIMINARY REPORT ON EXISTING ACTIVE PARTI-

CLE HAZARD-200 AREAS. M. L. Mickelson. Oct. 22, 1947. Decl. Feb. 18, 1957. 3p. Contract [W-31-109-Eng-52]. \$1.80(ph), \$1.80(mf) OTS.

Surveys by the Health Instrument Section disclosed the presence of many small radioactive spots on ground surfaces in the T and B plant areas. Investigation has shown that representative samples of the spots when mechanically separated invariably end in a single radioactive particle. Presumably these particles are being dispersed by the T and B plant stacks. Microscopic inspection of a particle showed a small nucleus of some porous material upon which is deposited a substance having a crystalline appearance. (W.D.M.)

9890 HW-59066

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE NUCLEAR SAFETY OF FISSILE MATERIALS. E. D. Clayton. Feb. 11, 1959. 30p. Contract [W-31-109-Eng-52]. \$4.80(ph), \$2.70(mf) OTS.

The usual procedure followed in critical mass experiments is either to place the potential reactor in a heavily shielded cell or to conduct the experiments remotely, in which case distance provides a measure of safety in the event of an unscheduled radiation burst. In considering potential criticality incidents, especially for personnel not specifically engaged in critical mass studies, it is likely that at the time of the incident neither the conditions of shielding nor distance will prevail. A total of twelve accidental bursts have taken place in this country which have involved "experimental" assemblies. These radiation incidents included reactor systems of both fast and thermal types. Some recent radiation incidents are described. Critical parameters are discussed in detail. (A.C.)

9891 M-4130

Hanford Engineer Works, Richland, Wash.

STUDIES IN THE ACCUMULATION OF RADIOACTIVE ELEMENTS IN ONCORHYNCHUS TSCHAWYTSCHA (CHINOOK SALMON) EXPOSED TO A MEDIUM OF PILE EFFLUENT WATER. K. E. Herde. Oct. 14, 1946. Decl. Mar. 7, 1957. 21p. Contract [W-31-109-Eng-52]. (HW-3-5064). \$4.80(ph), \$2.70(mf) OTS.

Data are presented on the accumulation of Na²⁴ and other longer lived elements in fish. The work reported was carried out primarily to determine total accumulation of radioactive elements in fish. Data are reported on rates of accumulation of radioactive materials during various controlled exposure periods, variations in amount of accumulation with water temperature, evidence of accumulation of varied amounts of longer lived materials, significance of the excretion factor when fish containing Na²⁴ are replaced in fresh water, and individual variations in fish as to their metabolism buffer ability or tolerance to such materials. (W.L.H.)

9892 M-6472

Brookhaven National Lab., Upton, N. Y.

STRONTIUM-90: BIBLIOGRAPHY. M. Comstock. Dec. 31, 1957. 10p. \$1.80(ph), \$1.80(mf) OTS.

Nuclear Science Abstracts, Chemical Abstracts, and the Brookhaven National Laboratory library files were searched for all aspects of the literature on strontium-90. One hundred forty-nine references are listed. (C.H.)

9893 M-7001

Nevada Test Organization. Off-Site Radiological Safety Activities, AEC.

REPORT OF OFF-SITE RADIOLOGICAL SAFETY

ACTIVITIES, OPERATION TEAPOT, NEVADA TEST SITE, SPRING, 1955. J. B. Sanders, O. R. Placak, and M. W. Carter. 156p. \$24.30(ph), \$7.50(mf) OTS.

A summary is presented of off-site radiological monitoring activities during Operation Teapot at the Nevada Test Site in the Spring of 1955. The AEC radiological criteria for the protection of the public are reviewed. The organization, methods, and equipment are described. A list is included of motion picture films shown in the area. Public relations activities are reported. Data are included from monitoring runs and dosages, airway closures, cloud tracking and low-level terrain surveys, dosages at all populated places where the external gamma dosage rate reading was greater than 0.1 mr/hr at selected values in nonpopulated areas such as the maximum dosage, and dosage at points where the fall-out crossed main highways. Maps are included showing fall-out prediction, cloud tracking, results of low-level terrain surveys, and ground survey data. A brief summary of results is included for each nuclear device detonated during the test series. (C.H.)

9894 M-7002

[Nevada Test Organization. Off-Site Radiological Safety Activities, AEC.]

REPORT OF OFF-SITE RADIOLOGICAL SAFETY ACTIVITIES, PROJECT 56, NEVADA TEST SITE, WINTER, 1955. J. B. Sanders, O. R. Placak, M. W. Carter, M. Page, Jr., and C. Y. Jordan. 100p. \$15.80 (ph), \$5.70(mf) OTS.

Off-site operations were designed to delineate the direction, size, and relative intensity of the fall-out pattern, to measure the height of the cloud produced by each detonation, and to estimate the exposure levels to Nevada Test Site personnel and to nearby populations. The results of these various activities are reported. (W.D.M.)

9895 M-7028

Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn.

ENVIRONMENTAL RADIOACTIVITY AT CANEL. Summary of Data for 1957. Gerald W. Kerr. Dec. 22, 1958. 11p. \$3.30(ph), \$2.40(mf) OTS.

Samples of water, soil, silt, rain water, drinking water, Connecticut River water, waste solutions from two retention tanks, and air collected on the site and in the environs of the CANEL site from May 1 through December 31, 1957, were analyzed for radioactivity. Procedures are described, and data are tabulated. The levels of activity found were insignificant in relation to maximum permissible concentrations as set forth in the Federal Register and Sanitary code of the Connecticut State Department of Health. (C.H.)

9896 M-7029

Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn.

ENVIRONMENTAL RADIOACTIVITY AT CANEL. Summary of Data for 1958. Gerald W. Kerr. Mar. 18, 1959. 16p. \$3.30(ph), \$2.40(mf) OTS.

The environmental monitoring program at CANEL in 1958 consisted of collection and analysis of water, soil, silt, drinking water, Connecticut River water, process water, domestic sewer water, Connecticut River silt, precipitation, fall-out, and air. The CANEL facility has two retention tank vaults which are designed to collect laboratory wastes which have the potential of being radioactive. These tanks are sampled and analyzed before they are permitted to be released to the

Connecticut River. All samples are analyzed for gross alpha and beta activity. Readings obtained by the CANEL environmental monitoring group range from 7.3 to 24.0 μ r/hr. The average of 448 readings (with 95% confidence limits) yields 14.86 ± 1.34 μ r/hr. These results are not greatly different in magnitude, and it is concluded that the CANEL results are fairly accurate as a measurement of radiation levels in this area. The level of 24 μ r/hr would result in a total of 4.032 mr for a 7-day period. This is only 4.032% of the permissible levels as specified in the Federal Register. (auth)

9897 M-7139

Los Alamos Scientific Lab., N. Mex.

THE ATOMIC BOMB—LET'S FACE IT. J. F.

Spalding. [1957?]. 19p. Contract [W-7405-eng-36]. \$3.30(ph), \$2.40(mf) OTS.

The hazards from an atomic explosion are discussed in terms of blast, thermal heat, instantaneous nuclear radiation, and residual radioactivity. The talk was presented at the University of New Hampshire to an open meeting of agricultural and livestock people. (W.D.M.)

9898 NYO-2367

Del Electronics Corp., Mount Vernon, N. Y.

FEASIBILITY STUDY ON AN ELECTROSTATIC STRATOSPHERIC DUST SAMPLER. H. J. Di Giovanni, Raymond Kaufman, and David A. Rudich. Dec. 15, 1958. 38p. Contract AT(30-1)-2173. \$6.30(ph), \$3.00(mf) OTS.

A theoretical study of the behavior of particles, ranging in size from 0.01 to 1 micron, in a stratospheric electrostatic precipitator for operation from 60,000 feet to 100,000 feet was performed. Results indicate that it is feasible to design and build electrostatic precipitators having over-all efficiencies approaching 100%. (auth)

9899 NYO-4648

New York Operations Office. Health and Safety Lab., AEC.

STABLE STRONTIUM AND RADIUM SURVEY AT FIVE PASTURE SITES IN THE UNITED STATES. George A. Welford, comp. May 25, 1955. Decl. Jan. 30, 1956. 11p. \$3.30(ph), \$2.40(mf) OTS.

Data are presented on the 1953 levels of stable strontium and radium in samples of soil and bone from five selected pasture sites in North Carolina, New York, Georgia, Utah, and New Jersey. Data are tabulated on the influence of ionic calcium on the uptake of stable strontium and radium from soil, the relationship between radiostrontium and stable strontium in bone, the efficiency of various leaching agents for recovery of normal strontium from soil, and the strontium-90, radium, and stable strontium content of bone ash from livestock grazed in pastures at each site. (C.H.)

9900 NYO-4649

New York Operations Office. Health and Safety Lab., AEC.

STUDIES OF FACTORS IN THE UPTAKE OF Sr^{90} . SITE SURVEY—FALL, 1954. George A. Welford, comp. June 6, 1955. Decl. Jan. 30, 1956. 28p. \$4.80 (ph), \$2.70(mf) OTS.

A survey was made of levels of strontium-89 and strontium-90 from fall-out in samples of soil, vegetation, and animal bone collected from selected pasture sites in North Carolina, New York, Georgia, Utah, and New Jersey during 1953 and 1954. The bone levels

showed an average increase by a factor of 2.4. Data are presented graphically showing the relationship of the calcium content in the soil to strontium-90 uptake in animal bones. The ratio of strontium-90 to strontium-89 in the uptake cycle at each site was determined. The fall-out at each site during the animal grazing period and the vegetation growth period was collected on gummed paper exposed for weekly intervals at each site. Data are tabulated. The vegetation collected at the end of the growth period showed a strontium-90 to strontium-89 ratio similar to the fall-out material for the period. This was considered evidence of leaf retention. (C.H.)

9901 OTO-57-3

Nevada Test Organization. Off-Site Radiological Safety Activities, AEC.

OPERATION PLUMBBOB OFF-SITE RADIOLOGICAL SAFETY REPORT. O. R. Placak, M. W. Carter, and R. A. Gilmore, comps. and eds. 1957. 212p. \$33.30 (ph), \$9.60(mf) OTS.

A summary is presented of off-site radiological monitoring activities during Operation Plumbbob at the Nevada Test Site in 1957. AEC radiological safety criteria for the protection of the public are reviewed. The organization, methods, and equipment are described. Public relations activities are reported. Activities and procedures of the medical and veterinary groups are summarized. Data are included from monitoring runs and dosages, weathering studies, shielding studies on structures and vehicles, activity in milk and water samples, air sampling results, and continuous recorder results. A brief summary of results is included for each nuclear device detonated during the test series. Maps are included which depict gamma dosage in terms of infinite and estimated dose. A table is presented of doses in populated areas where the infinite dose exceeded 10 mr. (C.H.)

9902 SRO-29

Savannah River Operations Office. Technical and Production Div., AEC.

REVIEW OF THE S.R.P. ENVIRONMENTAL CONTROL PROGRAM AND THE INFLUENCE OF NUCLEAR WEAPONS TESTING. Karl E. Herde. Jan. 30, 1956. 22p. \$4.80(ph), \$2.70(mf) OTS.

A systematic sampling of the environment for radioactivity was begun at the Savannah River Plant in 1951. Data collected during 1951, 1952, 1953, and 1954 are summarized. Over 300 radioanalyses per month were made on samples of vegetation, surface waters, municipal water supplies, and atmosphere collected in the environs. The weapons testing programs of the various nations temporarily affected background levels, thus complicating monitoring of internal contamination. An accurate interpretation was made of airborne contamination. Some of the best data upon both local and external contamination were collected by relatively simple and inexpensive techniques. Particle collection and monitoring procedures are described. Fall-out levels are correlated with weapons tests. The amount of fall-out was several orders of magnitude below that having a health significance to the populace of the area. (C.H.)

9903 TID-5035

New York Operation Office. Health and Safety Div., AEC.

SURVEY OF FALL-OUT OF RADIOACTIVE MATERIAL FOLLOWING THE LAS VEGAS, NEVADA TEST EX-

PLOSIONS. Feb. 27, 1951. Decl. Aug. 17, 1956. 36p. \$6.30(ph), \$3.00(mf) OTS.

An investigation has been made of the radioactive fall-out in snow following the Las Vegas, Nevada, testing explosion. Snow samples were collected during Feb. 1951 in New York State, New Jersey, Pennsylvania, Delaware, and Ohio and analyzed. Radioactivity of the snow ranged from less than 10 to 25,000 beta disintegrations/min./liter. The decay rate was equivalent to a half life of 74 to 85 hours. (C.H.)

9904 UWFL-18

Washington, Univ., Seattle. Applied Fisheries Lab. RADIOLOGICAL ANALYSIS OF BIOLOGICAL SAMPLES COLLECTED AT ENIWETOK, MAY 16, 1948.

Lauren R. Donaldson, Allyn H. Seymour, and John R. Donaldson. Decl. Mar. 5, 1957. 11p. Contract W-28-094-eng-33. \$1.80(ph), \$1.80(mf) OTS.

On May 16, 1948, the day following the Runit Island test, a collection of marine organisms was made from the reef area north of the test site within the general fall-out pattern. Collecting methods, preparation of material for counting, counting methods, and data from various parts of the organisms are given. Half life of the activity was approximately 180 days and was tentatively identified as Na^{24} and Ca^{48} . (W.D.M.)

9905 IGRL-T/W/94

INVESTIGATIONS ON THE RADIOACTIVITY OF ATMOSPHERIC PRECIPITATION AND THE ACTIVITY OF THE AIR. PART 4. W. Gerlach, K. Stierstadt, and I. Zeising. Translated by T. Rigg (U.K.A.E.A., Risley) from *Atomkernenergie* 3, 222-7(1958). 13p.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 11494.

9906

HEALTH ASPECTS OF NUCLEAR TECHNOLOGY.

Niel Wald (Univ. of Pittsburgh). *Arch. Ind. Health* 19, 345-9(1959) Mar.

The scope of nuclear technology in industry is reviewed. Health aspects are considered from the standpoint of the prevention and management of radiation exposures. Present-day concepts of tolerance-dose levels and new aids in handling accidental exposure cases are discussed. The need is stressed for more trained radiation health specialists. (C.H.)

9907

A PORTABLE CONTINUOUS ANALYZER FOR GASEOUS FLUORIDES IN INDUSTRIAL ENVIRONMENTS.

O. H. Howard and C. W. Weber (Oak Ridge Gaseous Diffusion Plant, Tenn.). *Arch. Ind. Health* 19, 355-64 (1959) Mar.

An inexpensive portable fluoride analyzer has been developed for the continuous monitoring of environmental atmospheres. This report describes the design and development of the analyzer and presents inplant results which have revealed fluoride concentration peaks that are not resolved by present methods of analysis. (auth)

9908

THE DISTRIBUTION OF 'FALL-OUT' RADIO-STROMTIUM IN A SHEEP SKELETON. A. Morgan and Jennifer E. Wilkins (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Biochem. J.* 71, 419-22(1959) Mar.

A method is described for the determination of Sr^{90}

and Sr^{90} in animal bone by radiochemical analysis. The results are given of Sr^{88} , Sr^{90} , and stable-strontium analyses on serial sections from a tibia of a yearling sheep. Results of Sr^{90} determinations on various bones are given and show that the maximum variation from the skeletal average is only about 10%. The results and their significance are discussed. (auth)

9909

WORKING TECHNIQUES IN RADIOISOTOPE LABORATORIES. Daniel Vödrös. *Energia és Atomtech.* 11, 310-12(1958) Apr.-May. (In Hungarian)

Personnel safety, remote control instruments, and shielding in laboratories preparing and handling radioisotopes are discussed. The problems of storage and transportation of radioactive materials are also analyzed. (R.V.J.)

9910

RADIATION EXPOSURES FROM NUCLEAR TESTS AT THE NEVADA TEST SITE. G. M. Dunning (U. S. Atomic Energy Commission, Washington). *Health Phys.* 1, 255-67(1958) Dec.

A summary of the pertinent data on radiation exposures from nuclear tests in Nevada is presented. The data are presented in categories of external γ radiation, activity concentrations in air, and activity concentrations in water. Methods used to estimate exposure and to evaluate data are described. The data are tabulated. The maximum external exposure was 7 to 8 r for 15 persons involved. In terms of relatively large populations, the average exposure for the 1,000,000 people living nearest the site was at the rate of $\frac{1}{4}$ r/30 yr. The highest concentration of fall-out activity in the air was about $1.3 \mu\text{c}/\text{m}^3$ averaged over the 30 hr that the activity was present in significant quantities. The highest concentration of fall-out activity in a potential drinking water supply was about $1.4 \times 10^{-4} \mu\text{c}/\text{me}$ extrapolated to D + 3 days. Evaluation of these data is given. (auth)

9911

ELECTRONIC DATA PROCESSING AND RADIATION EXPOSURE RECORDS. I. C. Nelson (General Electric Co., Richland, Wash.). *Health Phys.* 1, 345-51(1958) Dec.

A description is given of an application of electronic data processing methods to the maintenance of Radiation Exposure Records at the Hanford Atomic Products Operation. Descriptions pertaining to magnetic tape records, punched card inputs, computer dose determination, reports, relative costs, and record storage are given. One year's successful operation has proven the worth of the application. (auth)

9912

PROBABILITY OF HUMAN CONTACT AND INHALATION OF PARTICLES. L. Schwendiman (General Electric Co., Richland, Wash.). *Health Phys.* 1, 352-5(1958) Dec.

Experiments were performed using fluorescent zinc sulfide as a simulant for radioactive particulates to determine order of magnitude probabilities of contact with, or breathing by, workers doing typical operations. Attention was given only to outdoor work, or work which might bring individuals in contact with particles initially deposited on outdoor surfaces. Probabilities ranged from 1×10^{-2} to 1×10^{-4} particles per unit area per particle per unit ground area for transfer from ground to clothing per hour. Probability of breathing a particle while performing typical operations involving vehicles showed probabilities ranging from 6×10^{-4} /hr for

driving a vehicle to 6×10^{-4} for sweeping a bus when a single particle was present. Other operations and probabilities are discussed. (auth)

9913

DETERMINATION OF THE AIR POLLUTION AND THE SOIL IRRADIATION CAUSED BY THE "VARIATION" OF A REACTOR IN NORMAL OPERATION.

C. Jehanno and C. Lallemand (Centre d'Etudes Nucléaires, Saclay, France). *Intern. J. Air Pollution* 1, 221-30(1959) Jan. (In French)

The amount of argon-41 ejected by the stack of the EL2 reactor and the corresponding amount of γ radiation received at ground level in the neighborhood of Saclay due to the argon-41 were determined. The methods used are described. The concentration of argon-41 in the air of the stack is proportional to the reactor power and the amount is about $3 \times 10^{-4} \text{ c}/\text{m}^3$ for 2 Mw. Since the air flow is $5.5 \text{ m}^3/\text{sec}$, the stack emits $1.7 \times 10^{-3} \text{ c}$ of argon-41 per second when the reactor is running at 2 Mw. The greatest γ activities at ground level outside the Centre due to argon-41 have been measured during a period of temperature inversion; they correspond roughly to $80 \mu\text{r}/\text{hr}$. (auth)

9914

PARAFFIN WAX MAY BE BETTER FOR SHIELDING. RESEARCHERS FEEL HYDROGEN ATOMS IN WAX COULD ABSORB MORE NEUTRONS THAN PLASTICS.

W. C. Parle and A. M. Erskine (California Ink Co., Inc., Berkeley). *Missiles and Rockets* 5; No. 11, 34 (1959) Mar. 16.

The development of lead-dispersed-in-wax shielding and its manufacture are described. The physical properties and shielding effectiveness of this material are given. (T.R.H.)

9915

CONCRETE FOR BIOLOGICAL SHIELDING. A. L. Brake. *Nuclear Energy Eng.* 142-5(1959) Mar.

The guiding factors, essential properties, and data required in selecting a concrete for reactor biological shielding are discussed. The use of limestone, ilmenite, magnetite, and barytes as aggregates is evaluated. The piping, compaction, and testing of such concretes are briefly discussed. (T.R.H.)

9916

PRESENCE OF ^{60}Co IN THE ATMOSPHERE.

L. Marquez, N. L. Costa, and I. G. Almeida (Centro Brasileiro de Pesquisas Físicas, Rio de Janeiro).

Nuovo cimento (10) 11, 111-12(1959) Jan. 1.

The presence of ^{60}Co in the atmosphere was established by collecting a few thousand liters of rainwater, adding Co carrier to it, and processing it through an ion exchange column to retain the cations. The process of extracting the Co is described. By examining the reaction which might produce ^{60}Co , the conclusion is reached that nuclear tests having mostly fission could not account for the ^{60}Co observed, since all the reactions produced by neutrons require thresholds of 12 Mev or greater. Measurements made from January to July 1958 on ^{60}Co and ^{54}Mn indicate that the bulk of ^{60}Co is produced in thermonuclear tests. (A.C.)

9917

CERTAIN POSSIBILITIES OF IMPROVED SAFETY IN HANDLING RADIOACTIVE SUBSTANCES. V. Drasil. *Pracovní lékařství* 9, 531-3(1957). (Translated from *Referat. Zhur. Khim.* No. 22, 1958, Abstract No. 74459.)

To prevent contamination of laboratories with trace

quantities of radioactive isotopes (RI) it is recommended that rubber or polyethylene bags be used for the purpose of accommodating and storing certain laboratory equipment that has been exposed to RI. Such items as test tubes containing RI, hypodermic needles, and small laboratory animals are included. Rubber surgical gloves, washed with glycerine, may be employed for the purpose. In order to catch RI evolved during evaporation procedures, a vessel containing RI is placed in a $\frac{1}{2}$ crystallization dish, the top of which is covered with several layers of filter paper.

7910

EFFECTS OF FALLOUT RADIATION ON A HUMAN POPULATION. R. A. Conard, J. S. Robertson, and W. Wolins (Brookhaven National Lab., Upton, N. Y.); L. M. Meyer (South Nassau Communities Hospital, Rockville Center, N. Y.); W. W. Sutow (M. D. Anderson Hospital, Houston, Texas); and H. Hechter (Naval Radiological Defense Lab., San Francisco). Radiation Research Suppl. 1, 280-95(1959).

An unpredicted shift in winds shortly after the detonation of a large thermonuclear device during Operation Castle at Bikini Atoll, Pacific Proving Grounds, on March 1, 1954, caused deposition of significant amounts of fall-out on four nearby inhabited Marshall Islands. A survey was made to determine the exposure of the island inhabitants. Twenty-eight American servicemen on Rongerik Atoll received about 70 r and 23 Japanese fishermen aboard their fishing vessel, the Lucky Dragon, received significant exposure. Sixty-four inhabitants of the island of Rongelap, 105 nautical miles away from the detonation, received an estimated dose of fall-out equivalent to 175 r whole-body γ radiation and β -ray lesions of the skin, and slight internal absorption of radioactive material. Eighteen people on a nearby island received about 69 r. The status of 82 Marshallese people is reviewed four years after their exposure. Extensive physical examinations were carried out during the first 3 months after exposure, and repeated at six months and yearly intervals thereafter. A brief summary of findings from these surveys is included. Three deaths have occurred in the exposed group, but none was due to radiation exposure. No abnormalities were observed in the 18 babies born to exposed parents. During the discussion of this paper, M. Tsuzuki reported on the status of the 23 Japanese fishermen exposed in the same accident. Examination four weeks after exposure showed leukopenia and myelophthisis; after 6 weeks, disturbance of liver function and jaundice; after 3 months, hypo- or asperima. One case was lost as a result of severe hepatitis. After 4 years, all the surviving fishermen report feeling well and appear to be in good health. (C.H.)

7919

IMPORTANCE OF THE EXHAUST VALVE DESIGN IN GAS MASKS FROM THE STANDPOINT OF PROTECTION FROM RADIOACTIVE AEROSOLS AND OTHER SUBSTANCES. J. Tsarich. Tehnika (Belgrade) 13, No. 3, (1958). (Translated from Referat. Zhur. Khim. No. 22, 1958, Abstract No. 74494.)

The shortcomings of the design of exhaust valves of existing gas masks are briefly discussed. The importance of developing a new system capable of protection against various poisonous substances including the radioactive ones is emphasized.

7920

THE EFFECT OF RADIOACTIVE RAINS ON SURFACE

WATER SUPPLIES. R. L. Morris. Water & Sewage Works 105, 92-4(1958).

The amount of radioactivity was determined in samples of all precipitation at Iowa City, in daily samples of water from Iowa River, and in weekly samples from typical farm ponds in Johnson County and in other counties in southern Iowa, during the period July to October 1957. The results are given in tables and graphs. The occurrence of radioactivity in rain at levels above normal was in each case associated with previous abnormally high radioactivity of the air due to bomb detonation in Nevada; the isotopes in the rain had half lives of 5 to 9 days. The duration of high concentrations of radioactivity in the river was quite short, owing to the rapid rate of flow of the river. A large percentage of the radioactivity in the river water is contained in the suspended solids, and can therefore be removed by sedimentation, coagulation, and filtration, as in the treatment of Iowa University tap water. The amount and duration of radioactivity in the ponds were much greater than for similar periods in the river. Owing to the observed effects of radioactive fall-out in Iowa, it is recommended that farm ponds should be given careful consideration before use as a source of potable water supply. (auth)

7921

PUBLIC EXPOSURE TO IONIZING RADIATIONS. What Public Health Personnel Need to Know. New York, American Public Health Association, Inc., 1958. 60p.

Laws and regulations governing radiation exposure in the United States are summarized. The need is stressed for international regulations and agreements to ensure effective safeguards against radiation injury of citizens. Fundamental concepts of radiation protection are reviewed. The effects of radiological public health needs on present public health practices are discussed. (C.H.)

7922

ATOMIC RADIATION DANGERS AND WHAT THEY MEAN TO YOU. H. W. Heckstall-Smith. London, J. M. Dent & Sons, Ltd., 1958. 112p.

The hazards associated with natural radiation, industrial, medical, and research radiation, atomic and thermonuclear weapon explosions, and atomic plant operations are discussed. (T.B.A.)

7923

SAFE HANDLING OF ISOTOPES. Vienna, The International Atomic Energy Agency, 1958. 99p. \$1.00.

A guide to the safe handling of isotopes is presented. Small-scale users who may not have direct access to other sources of information may find the recommendations valuable. Much of the information included should be interpreted with scientific judgement since the choice of wording is precise. The guide covers such areas as medical supervision of workers, personnel exposure, and monitoring. In addition, information on handling sealed and unsealed sources is presented as well as transportation of radioactive material, accidents, decontamination, and waste disposal. Maximum permissible exposures are also discussed. (J.R.D.)

INSTRUMENTS

7924 AERE-ED/R-1566

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THEORY OF THE IDEAL A.C. CONDUCTION PUMP.

W. Murgatroyd. Dec. 2, 1954. 18p.

Equations are presented giving the pressure rise, ohmic loss, and impedances of an ideal a-c conduction pump. An ideal pump is one in which there are no end, tube, or friction losses. Curves are included to facilitate calculations of the relevant quantities. In an appendix the operation of a pump with compensating windings is analyzed. It is shown that there is an optimum length for this type of pump, and a corresponding minimum ohmic loss, which is dependent only upon the pressure rise, maximum field strength, frequency, and fluid properties. A table is included giving this loss under various practical conditions. (auth)

9925 AFOSR-TN-58-665

California. Univ., Berkeley. Electronics Research Lab.

THE ANALYSIS OF SAMPLED-DATA CONTROL SYSTEMS WITH A PERIODICALLY TIME VARYING SAMPLING RATE. F. J. Mullin and E. I. Jury. June 30, 1958. 26p. Contract AF18(600)-1521. (AD-162196).

A discussion is presented of sampled-data systems with only one sampler which has a periodically time varying sampling rate, i.e., the sampling pattern is repetitive. The z-transform is used in this analysis although matrix methods could be just as easily applied. The method can be used in problems of inventory control, production control, and in the operation research field. (W.D.M.)

9926 AFOSR-TN-58-1033

Western Reserve Univ., Cleveland.

ACOUSTIC DELAY LINE MEMORY FOR HUTCHINSON-SCARROTT KICKSORTER. Berol L. Robinson. Dec. 8, 1958. 6p. Contract AF18(603)-61. (AD-206483).

A quartz delay line unit was adapted to the multiple channel pulse-height analyzer of Hutchinson and Scarrott which includes transmitter, receiver, and pulse shaping circuits in a compact plug-in package. The unit operates at a clock rate of 1.00 mcps, and requires positive clock pulses and input signals, about ten volts in amplitude and clamped to a reference voltage; it produces shaped output pulses of the same character. (W.D.M.)

9927 CF-58-12-121

Oak Ridge National Lab., Tenn.

STABILITY TESTS ON THE TYPES IN430A AND IN430B AVALANCHE DIODE REGULATORS. J. L. Blankenship. Dec. 31, 1958. 11p. Contract [W-7405-eng-26]. \$3.30(ph), \$2.40(mf) OTS.

The manufacturers' specifications for temperature coefficient of voltage and internal impedance of the compensated avalanche diode types IN430A and IN430B appear quite promising. These devices could be used as shunt regulators in high stability power supplies if the noise and drift rate were sufficiently small. One investigator reported the voltage did not drift more than ± 0.002 per cent over a 7,000 hour period. Stability tests were performed on two diode samples under reasonable laboratory conditions. The measured drift rate did not exceed 0.005 per cent per month, and short term noise was less than ± 0.002 per cent. The actual diode drift rate may be even lower than the measured rate. (auth)

9928 HW-41681

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

HANFORD SPECIAL X-RAY PHOTOMETER—MARK II. T. R. Cartmell, comp. [nd]. 29p. Contract W-31-109-Eng-52. \$4.80(ph), \$2.70(mf) OTS.

The special x-ray photometer was designed to measure various characteristics of high-absorption materials by comparing the attenuation of an x-ray beam in passing through a sample of known size with the attenuation through a standard. A general description, discussion of elements, safety features and caution, alignment and adjustment, and operation and maintenance are presented. (J.E.D.)

9929 HW-57162(Rev.)

General Electric Co. Hanford Atomic Products

Operation, Richland, Wash.

A MULTICOLOR PYROMETER. B. B. Brenden and H. W. Newkirk. Nov. 11, 1958. 21p. Contract W-31-109-Eng-52. \$0.75(OTS).

The construction, calibration, and operation of a multicolor pyrometer are described. A single CdS cell is used to measure the relative amounts of energy radiated in each of three wave-length bands determined by interference filters. Analysis of the recorded output of the cell permits a determination of three two-color temperatures and one three-color temperature. None of the temperature measurements require a knowledge of the emissivity of the hot body. In addition, the three-color temperature measurement is insensitive to a specific variation of emissivity with wave length. Results show that the limit of reproducibility of the two-color temperature determination is $\pm 11^\circ\text{K}$, whereas the reproducibility of the three-color temperature determination is $\pm 160^\circ\text{K}$. (auth)

9930 HW-58302

General Electric Co. Hanford Atomic Products

Operation, Richland, Wash.

A FILAMENT FURNACE FOR HIGH TEMPERATURE MICROSCOPY. H. W. Newkirk, Jr. and J. L. Bates. Dec. 1, 1958. 15p. Contract W-31-109-Eng-52. \$0.50 (OTS).

A filament furnace is described which is suitable for heating gram quantities of materials at temperatures up to 3000°C under reduced pressures or in various atmospheres. A quartz window and shutter assembly permit the observation of the specimen by long-working-distance microscopes during the heating cycle. (auth)

9931 IGR-R/CA-245

United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst, Ches., England.

SONIC ANALYSER FOR THE CONTINUOUS MONITORING OF HYDROGEN IN TRITIUM. E. Harrison. Nov. 1957. Reprinted 1958. 18p.

A form of sonic analyzer using a welded stainless steel resonator was developed for monitoring the concentration of hydrogen in tritium over the range 0 to 100 and 0 to 15 at. % hydrogen; in the latter range a calculated calibration agrees with the actual calibration within 0.2 at. %. The construction, adjustment, and calibration of the resonator are described, together with the design of the associated electronic unit. (auth)

9932 IGR-TN/CA-1054

United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Ches., England.

AN INTERFEROMETER FOR TESTING THE FIGURES OF PLATES USED IN GAS-LUBRICATED THRUST BEARINGS. C. D. Reid. 1959. 14p.

Declassified version of RDB-(Cap)/8116.

The method of testing the figures of plates used in gas-lubricated thrust bearings by means of an optical flat placed in contact with the surface being tested is discussed. Some other methods of testing the plates are described, and an outline is given of the reasons for the choice of a particular type of interferometer for this purpose. The interferometer is described, with notes on its adjustment and use. The advantages of an interferometer over the present method are that it is faster to operate, the useful life of the reference optical flat is extended indefinitely; there is no danger of scratching either plate or flat, and the interference fringes can be more easily seen. For routine testing, it is suggested that an interferometer be used in place of the present contact methods. (auth)

9933 KAPL-873

Knolls Atomic Power Lab., Schenectady, N. Y.
A NIER TYPE MASS SPECTROMETER OF HIGH SENSITIVITY. F. A. White, T. L. Collins, and J. C. Sheffield. Appendix by G. M. Roe. Dec. 10, 1952. Decl. Jan. 26, 1959. 87p. Contract W-31-109-Eng-52. \$9.30(ph), \$3.60(mf) OTS.

A 12-inch radius of curvature Nier-type mass spectrometer utilizing a surface ionization source and an electron multiplier detector was constructed. This machine was built specifically to mass-analyze microgram samples of uranium containing less than 100 parts of U^{236} per million parts of U^{235} . Using a 20-stage electron multiplier, ion beam currents as low as 10^{-19} amp can be measured. A complete description of the instrument and its performance is given together with a discussion of its principal limitations. (auth)

9934 KAPL-1928

Knolls Atomic Power Lab., Schenectady, N. Y.
NEUTRON DETECTORS FOR HIGH-TEMPERATURE APPLICATIONS. E. B. Fehr. May 9, 1958. 13p. Contract W-31-109-Eng-52. \$0.50(OTS).

Neutron detectors for use in control and measurement of a critical assembly at temperatures up to 300°C are described. At this temperature, the available coaxial low-noise and high-voltage cables are at the limit of their usefulness even for intermittent operation. Thus, further development in the field of high-temperature insulation meeting the exacting requirement of this application is a prerequisite for operation of chambers and counters at higher temperatures. (auth)

9935 KAPL-M-DWJ-11

Knolls Atomic Power Lab., Schenectady, N. Y.
A SIMPLE MEANS OF DETECTING RADIOACTIVE GASES IN THE SHIP'S ATMOSPHERE. David W. Johnson. Feb. 26, 1959. 31p. Contract W-31-109-Eng-52. \$6.30(ph), \$3.00(mf) OTS.

Tests and analysis of methods of detecting β -ray airborne activity due to fission gases are described. The need for some simple airborne activity detector to detect radioactive gases has been brought about by the smidgeon problem on S3G and S4G. A recommendation is made for a particular type of instrument to be installed in living quarters and in the engine rooms of S4G. (auth)

9936 KAPL-M-RMM-4

Knolls Atomic Power Lab., Schenectady, N. Y.
LECTURE NOTES—RANDOM VIBRATION. R. M. Mains. Jan. 12, 1959. 18p. Contract W-31-109-Eng-52. \$3.30(ph), \$2.40(mf) OTS.

The history of random vibration testing is presented. The early methods for determining the effects of random vibration on various types of equipment are discussed. (W.L.H.)

9937 LA-2275

Los Alamos Scientific Lab., N. Mex.
MODEL 1 ELECTRO-OPTIC LIGHT MODULATOR SYSTEM. William P. Aiello. June 13, 1958. 21p. Contract W-7405-eng-36. \$0.75(OTS).

A practical light modulator system is described which was designed for use with the Model 100 rotating mirror camera in order to provide an accurate method for calibrating such a camera. When a 5 Mc rf signal of sufficient amplitude is applied to a Baird Model EV-1 electro-optic light modulator, the light emitted from a high intensity flash tube is effectively modulated at a 10 Mc rate, thus establishing timing markers on the film of the rotating mirror camera which are spaced 0.1 μ sec apart. A description of the Baird electro-optic light modulator is included, as well as a discussion of the optical system and electronics equipment required for such an application. (auth)

9938 NARF-59-12T

Convair, Fort Worth, Tex.
CONTROLLED-TEMPERATURE SUBMERSIBLE IRRADIATION CHAMBER DESIGN. E. M. Nelson and W. L. Hopper. Mar. 10, 1959. 37p. Project No. 6(1-9964). Contract AF33(600)-32054. (MR-N-199).

Three boron-clad submersible irradiation chambers capable of being heated or cooled to temperatures between -65 and 400°F were designed and built to permit irradiations of aircraft materials and components under controlled-temperature conditions while positioned adjacent to the Ground Test Reactor. Design features and performance characteristics are described and discussed. (auth)

9939 NBS-6218

National Bureau of Standards, Washington, D. C.
THE USE OF IONIZATION CHAMBERS AS SECONDARY STANDARDS OF X-RAY EXPOSURE. John S. Pruitt and Steve R. Domen. Nov. 1958. 20p., 3 illus. NBS Project 0411-11-3156. \$7.80(ph), \$3.30(mf) OTS. Supersedes NBS-5923.

The use of calibrated ionization chambers to determine the total amount of energy transported by a well collimated bremsstrahlung beam, with a peak energy between 18 and 170 Mev, is discussed. Three chambers are described which have been used for this purpose, and their relative merits are discussed. The first chamber is an r-thimble which was calibrated calorimetrically between 18.2 and 36.7 Mev. The other two chambers are flat chambers, designed to intercept the entire beam. They were calibrated calorimetrically in the same energy range, and in addition, they were calibrated with a total absorption crystal spectrometer at a variety of energies up to 170 Mev. These calibrations are all presented, and compared with those obtained in other laboratories, where possible. (auth)

9940 NP-7345

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems.
EXPERIMENTAL DEVICE WITH A RING-SHAPED SCATTERER FOR INVESTIGATION OF HIGH ENERGY NEUTRON SCATTERING AT SMALL ANGLES. B. M. Golovin, V. P. Dzhelepov, Yu. V. Katyshev, A. D. Konin, and S. V. Medvedev. 1958. 8p.

An experimental device with a ring-shaped scatterer for investigation of high-energy neutron scattering is described. A telescope of scintillation counters with an aluminum converter is used as a neutron detector. The device makes it possible to carry out measurements with neutron beams of comparatively low intensity and can be successfully used in experiments on small-angle scattering. (W.D.M.)

9941 NYO-8523

Rensselaer Polytechnic Inst., Troy, N. Y.
AN INFRARED CELL ASSEMBLY FOR VOLATILE SOLIDS. George J. Janz and S. S. Danyluk. Oct. 1958. 9p. Contract AT(30-1)-1999. \$1.80(ph), \$1.80(mf) OTS.

A controlled atmosphere infrared cell assembly suitable for study of readily volatile solids of basically simple design is described. The assembly has been found particularly useful for the study of the crystalline substrates that frequently separate from mixtures of dry hydrogen halides with anhydrous polar organic solvents. (auth)

9942 RDB(C)-8051

Gt. Brit. Culcheth Labs., Culcheth, Lancs, England.
A PROPORTIONAL CONTROLLER OF FURNACE TEMPERATURE. G. D. Bell and E. Proudfoot. June 19, 1953. 12p.

The design of a proportional furnace controller is described. The controller is actuated by a thermocouple but it may be modified for use with a resistance thermometer. The control accuracy is $\pm 0.1^\circ\text{C}$ at 800°C or less. (auth)

9943 RDB(W)-8036

Gt. Brit. Windscale Works, Sellafield, Cumb., England.
THE DETECTION, IDENTIFICATION AND MEASUREMENT OF ALPHA EMITTERS IN AEROSOLS. N. Winogradoff. Oct. 29, 1952. 35p.

The practical aspects of the identification and measurement of alpha emitters in aerosols are discussed and the problem reviewed in the light of recent data on argon ionization energies. The construction and performance of a gridded chamber meeting the requirements of the problem are described, and the effect of chamber capacity on energy resolution is discussed. The results of laboratory and operational tests of the instrument are described and show that many long-lived alpha emitters can be easily and rapidly detected and identified. (auth)

9944 RDB(W)-8041

Gt. Brit. Windscale Works, Sellafield, Cumb., England.

AN APPARATUS FOR CALIBRATING HEALTH PHYSICS FILM PACKS FOR RESPONSE TO X-RADIATION. F. R. Charlesworth. Dec. 30, 1952. 18p.

A guard-plate air ionization chamber was constructed to measure the quantity of ionization produced in a known volume of air by a collimated beam of x rays. By measuring this quantity of ionization, it was possible to calculate the intensity of radiation from an x-ray tube, operating at voltages below 100 kilovolts, in roentgens per second. The purpose of the apparatus is to provide some reliable standard against which the film pack can be calibrated for response to a beam of x rays of heterogeneous energies less than 100 Kev. (auth)

9945 RDB(W)/TN-107

Gt. Brit. Windscale Works, Sellafield, Cumb., England.

A PILE POWER METER. J. A. Mounsey. Nov. 1953. 11p. (WTSC/R-116).

A description is given of an instrument intended for the measurement of low pile powers. A boron lined T.Q.T. chamber compensated against gamma radiation and coupled to a d-c amplifier is used. The instrument has four ranges covering powers from 1 kw to 1 Mw. (auth)

9946 RDB(W)/TN-221

United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England.
THE CALIBRATION AND USE OF ELECTROMAGNETIC FLOWMETERS IN 1 INCH S. S. PIPE CIRCUITS PASSING LIQUID METAL. (22% NaK). T. I. M. Crofts. Aug. 1955. 17p.

Electromagnetic flowmeters were calibrated. Methods employed and such factors as the effects of changes in pipe size, liquid temperature, and flow restrictions on flow measurements were given a limited study. The error due to angular displacement of the magnets between 0 to 32° was also studied. (auth)

9947 RISLEY-5198

Gt. Brit. Div. of Atomic Energy (Production), Risley, Lancs, England.

REPORT ON TESTS TO DETERMINE MOTOR SHEATH LOSSES. July 27, 1953. 19p. (DDC/P-5).

Tests were conducted to determine the sheath losses generally applicable to a 4 hp 245 cycle motor. The sheaths were designed to seal the rotor from the stator so that the stator windings would not be subjected to the process gas atmosphere in which the rotor would revolve. The test equipment, procedure, and test motor are described, and results are tabulated and graphed. A summary is also included. (J.R.D.)

9948 RISLEY-8071

Gt. Brit. Capenhurst Works, Capenhurst, Ches., England.

STRUCTURAL TESTS ON 14 in. AND 6 in. PROTOTYPE PROCESS GAS VALVES, USING AN ELECTRICAL RESISTANCE STRAIN GAUGING METHOD. F. O. Fletcher. Oct. 21, 1953. 28p. (CTSC/R-115).

Prototypes of new design 14 in. and 6 in. process gas valves have been tested for stress levels and stress distribution. Additionally, the 14 in. valve was tested to destruction. Results show that the stress distribution is satisfactory and that at normal operating torque the maximum stress is 458 lbs/in.² and 257 lbs/in.² for the 14 in. and 6 in. valve, respectively. The maximum stress in the 14 in. valve when operated at normal closing torque while subject to a bending load of 1,500 lbs, estimated to simulate plant conditions, was 625 lbs/in.². On the destruction test the 14 in. valve failed due to buckling of the operating spindle, at a torque load equal to 14.5 times the normal operating torque. (auth)

9949 SCTM-11-59(51)

Sandia Corp., Albuquerque, N. Mex.

A MUTUAL INDUCTOR FOR MEASUREMENT OF SPARK DISCHARGE SURGE CURRENTS. J. M. Proud, Jr. Jan. 16, 1959. 18p. Contract AT(29-1)-789. \$3.30(ph), \$2.40(mf) OTS.

A coaxial mutual inductor of the type first designed by Park was constructed to monitor the current waveform encountered in spark discharges. The inductor has a current capability of at least 10^6 amperes for brief intervals and has a flat frequency response from 0 to

10^8 cycles. Reasons for selecting a mutual inductor instead of the more common resistance shunt are discussed. (auth)

9950 UCRL-5375

California. Univ., Livermore. Radiation Lab. HIGH-CAPACITY RADIOMETRIC CALORIMETERS. Stuart R. Gunn. Nov. 13, 1958. 19p. Contract W-7405-Eng-48. \$0.75(OTS).

Calorimeters of the steady-state conduction type and flow type for precise determination of powers of radioactive samples from about 3 to 20 watts are described. One of the calorimeters is used under water to provide radiation shielding. Results of comparative measurements with these and other calorimeters at this laboratory and at the Mound Laboratory are given. (auth)

9951 USNRDL-TR-287

Naval Radiological Defense Lab., San Francisco. A SEMIAUTOMATIC ELECTROMAGNETIC BALANCE AND ITS APPLICATION TO THE DETERMINATION OF MOISTURE IN CELLULOSE. (With Appendix Describing Modifications for Automatic Recording Operation.) K. A. Lincoln. Dec. 2, 1958. 26p. (AFSWP-1115).

The construction, operation, and application of a new semiautomatic electromagnetic balance are described. The balancing of a load on the instrument by a torque-producing electrical current controlled by a d.c. amplifier is delineated together with the over-all circuitry of the system showing how this device permits rapid weighings by virtue of its single control and its direct-reading dial. Principles of operation are included along with information on calibration of the instrument and the remote-controlled weighing of samples in the 0 to 100 mg range. Accuracy of the instrument is considered to be 0.1 mg or better, and the standard error was found to be 0.03 mg. An additional feature of the balance is an electrical output which permits semiautomatic recordings of weighings. Measurements of the sorption and desorption characteristics of alpha-cellulose sheets using the electrobalance are described. The relationship between moisture content of the alpha-cellulose and the relative humidity (ranging from 0 to 93 percent) of its surrounding atmosphere is established. Additionally, it is demonstrated that the rate of moisture sorption varies inversely with the thickness of the sheets (between 4 and 30 mils), and 50 percent of equilibrium is reached in approximately two minutes and 99 percent of equilibrium is reached in ten minutes even for the 30 mil sheets. (auth)

9952 WADC-TR-58-158

Battelle Memorial Inst., Columbus, Ohio. INVESTIGATION OF EFFECTS OF RADIATION APPLICABLE AS GAMMA RADIATION DOSIMETERS. [Period covered] February 1957 through February 1958. J. F. Kircher, B. W. King, M. J. Oestmann, W. A. Hedden, J. H. Cahn, J. Moody, P. Schall, and G. D. Calkins. May 1, 1958. 110p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: MEASUREMENTS BY RADIATION. Contract AF33(616)-3905. (AD-155727; PB-151314). \$2.50 (OTS).

This project was initiated to survey the field of radiation effects to determine which effects might be useful for high-level gamma dosimetry. Accordingly, the approach has been to survey the literature in broad areas and then to initiate experimental studies in those cases where additional information was required for

evaluation of certain systems. It was not possible, however, to carry out experimental programs with all promising systems. The areas investigated fall into four general categories: organic systems, inorganic oxidation-reduction reactions, semiconductor materials and devices, and ceramics. Several promising organic systems are evaluated. Polymer systems and dye solutions will serve as dosimeters, but probably not to the high dosages desired. Reduction of metal oxides by hydrogen evolution from organic material holds promise but needs more study for proper evaluation. A theoretical study of gamma-ray effects in semiconductor materials points up the energy dependence of this effect. It was demonstrated, however, that simple semiconductor devices can function as very high-intensity dose rate meters. Several promising glass formulations were uncovered. These are primarily antimonate glasses, with and without added polyvalent metal oxides, and high-lead glasses. These glasses show promise of being useful dosimeters to the highest dosage of interest, 10^{12} ergs/g(C). (auth)

9953 WAPD-CDA(AD)-453

[Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh].

INSTRUCTIONS FOR THE INSTALLATION, OPERATION, AND MAINTENANCE OF THE BETTIS DISSOLVED OXYGEN ANALYZER, MODEL 3. J. M. Wright. Sept. 4, 1958. 18p. \$3.30(ph), \$2.40(mf) OTS.

The operation of the Bettis Dissolver Oxygen Analyzer (Model-3) is described. Dissolved oxygen can be measured in water in concentrations of 0.002 to 9 ppm. The analyzer is designed to sample at temperatures up to 140°F and pressures up to 2500 psi. Operation and maintenance are described, and a warning concerning the hazardous properties of thallium is included. Scale drawings and graphs are included. (J.R.D.)

9954 AEC-tr-3582

AN IMPROVED PHOTODEMENTOMETER. (Ein Verbessertes Photosedimentometer.) O. Telle. Translated for Los Alamos Scientific Lab. from Chem.-Ing.-Tech. 26, 684-6(1954). 6p. \$1.80(ph), \$1.80(mf) JCL or LC.

In the measurement procedure described earlier, rapid extinction measurement in suspensions yield particle-distribution curves which are equivalent to the results of the Andreasen pipet method and eliminate some of the sources of uncertainty inherent in the latter process. Technical refinements of the apparatus and results obtained in measurements with talc suspensions are reported. It is possible to reduce the time required for almost any particle analysis to 10 to 30 minutes. An additional 15 to 20 minutes is required for conversion of the experimental data into particle-distribution values. (auth)

9955 AERE-Trans-11/3/5/1139

MASS SPECTROMETERS WITH SECOND-ORDER DOUBLE FOCUSING. H. Hintenberger and L. A. König. Translated by A. H. Turnbull (U.K.A.E.A., Atomic Energy Research Establishment) from Z. Naturforsch. 12a, 773-85(1957). 29p. (Figures and Tables omitted). \$4.80(ph), \$2.70(mf) JCL or LC.

Mass spectrometers corrected for divergence errors are described. A system of five equations is used to determine the dimensions of the instrument. Three of the light unknowns in the equations are assumed to be known, and the dependence of the other five quantities on these three is investigated. An IBM magnetic drum

computer was used; the procedure is outlined. It is shown that second-order double focusing spectrometers can be used for deflections both in the same and opposite senses in electric and magnetic fields. The possibilities are summarized by tables and diagrams. (J.R.D.)

9956 SCL-T-226

BASIC PROPERTIES OF THE A-22-111 RADIOSONDE. (Osnovnye Osobennosti Radiozonda A-22-111.) V. A. Usol'tsev and K. N. Mamulov. Translated by Marcel L. Weinreich (Sandia Corp.) from *Nauch. Issledovatel'. Inst. Gldromet. Priborostroen*, No. 5, 3-16(1957). 37p. (Includes original, 15p). \$6.30(ph), \$3.00(mf) JCL or LC.

A radiosonde was developed which has greater precision than older models with little or no increase in cost of production. The instrument operates by the code method and is designed for temperature-wind sounding over a large network of aerological stations. This new radiosonde possesses the following fundamental properties: (a) in all the measuring nodes, the influence of the forces of external friction has been eliminated; and (b) the new arrangement has increased the precision of the measuring nodes. A semi-automatic register of radiosonde signals was developed which assures their being recorded on the ribbon in the form of curves representing the variations of the meteorological elements as a function of time. (A.C.)

9957 SCL-T-231

TEMPERATURE ADJUSTMENT OF A CERTAIN KIND OF RADIO-SONDE. G. Ishikawa. Translated by Noburu Hiraga (Sandia Corp.) from *J. Meteorol. Research, Tokyo*, 9, No. 9, 652-5(1957). 13p. \$3.30(ph), \$2.40(mf) JCL or LC.

Methods were investigated for maintaining constant temperature in radiosondes, such as painting the instrument section black and applying a coat of polyethylene. The analysis of other experimental results are also presented including a test in which 20% of the instrument section was painted white and 80% black. This test was conducted after sundown. The heat diffusion coefficients were determined, and it was concluded that a globe-shaped instrument section gives best results. (J.R.D.)

9958 SCL-T-232

MEASURING INSTRUMENTS FOR INDUSTRIAL METEOROLOGY. Masaki Koyano and Eizo Maruyama. Translated by Noburu Hiraga (Sandia Corp.) from *Tokyo, Weather Service B*, 24, 383-7(1957). 21p. \$4.80(ph), \$2.70(mf) JCL or LC.

The construction and use of numerous instruments for use in industrial meteorology are described in detail. The instruments described include thermometers, hygrometers, evaporimeters, rain gages, anemometers, and pyrheliometers. (A.C.)

9959 IGRL-T/CA-108

A LOW FREQUENCY ELECTRODELESS CONDUCTOMETER FOR MEASURING THE ELECTRICAL CONDUCTIVITY OF SOLUTIONS. M. Salamon and P. Svitok. Translated by L. H. Sinclair (U.K.A.E.A., Risley) from *Chem. Prumysl*, 6, No. 31, 10-14(1956). 12p.

Brief reviews of the measurement of the electrical conductivity of electrolytes with the use of electrodes, and of high frequency measurements without electrodes (conductometers) are presented and, a new type of conductometer is described working at mains frequency. The apparatus, by virtue of its size, may be used in

full-scale plant measurement. An automatically stabilized electronic bridge, adapted from the automatic potentiometer EPD-07, is used for the measurement. The conductometer is intended mainly for the measurement of brine and sulfuric acid concentrations. (auth)

9960

APPLICATION OF NUCLEAR MAGNETIC RESONANCE TO FIELD MONITORING AND CONTROL IN MASS AND ALPHA ENERGY SPECTROMETRY. James C. Sheffield and Frederick A. White (Knolls Atomic Power Lab., Schenectady, N. Y.). *Appl. Spectroscopy* 12, 12-16(1958).

Nuclear magnetic resonance instrumentation was applied to mass spectrometers in several arrangements of magnet field stabilization and control and as a monitor of the relative fields of paired magnet systems. Precise measurements of the magnetic field of an alpha spectrometer were made in determining alpha particle energies by monitoring the resonance frequency with an accurate frequency meter. (auth)

9961

METHODS FOR THE DETERMINATION OF THE OPTIMUM CATHODE THICKNESS OF G-M COUNTERS FOR GAMMA RADIATION. H. Gebauer (Fa. Frieske & Hoepfner GmbH, Erlangen-Bruck, Ger.). *Atomkern-energie* 4, 62-4(1959) Feb. (In German)

When choosing the thickness of the cathode of Geiger-Mueller counter tubes, it is, in general, sufficient to refer to the approximate value which means that the thickness should be the same as the practical range of the secondary electrons with the maximum energy. Only a few exact results are available at present. For the gamma radiation from Co^{60} , the optimum cathode thicknesses for aluminum, steel, copper, brass 60, and lead were measured, fulfilling the relation $d_{\text{opt}} = 3.0/Z^{1.14}$ [cm]. The measured and calculated values for the optimum cathode thickness coincide with the approximate values only for the element aluminum. The practical consequences incurred by the discrepancy between measured and approximate values for choosing the cathode thickness is discussed in an example. The discussion shows that at least for the gamma energy range of the Co^{60} under consideration here, the discrepancy causes only a negligible decrease in the counting efficiency of a counter tube. The measurements were carried out according to a new method which will be described more closely. (auth)

9962

A HIGH RESOLUTION FLAT CRYSTAL SPECTROMETER FOR NEUTRON CAPTURE γ -RAY STUDIES. J. W. Knowles (Atomic Energy of Canada, Ltd., Chalk River, Ont.). *Can. J. Phys.* 37, 203-31(1959) Feb.

A flat-crystal diffraction spectrometer, constructed for the measurement of γ rays resulting from neutron capture, is discussed both experimentally and theoretically. The spectrometer is used either as a single crystal or a double crystal instrument. In the single crystal arrangement a Laue diffracted γ -ray beam from a broad source proceeds through a Soller slit which gives it a 45-second angular divergence, to a sodium iodide scintillation detector. The energy is determined by the angle between the Soller slit and the crystal. The resolution is determined by the Soller slit, and is 4% at 1 Mev when diffracting from the (440) planes of a single germanium crystal. In the two-crystal configuration a γ ray which is Laue diffracted from the first crystal is further diffracted from a second crystal set in the anti-

parallel position. The angle between the reflecting planes of the two crystals determines the γ -ray energy. The Soller slit serves only as shielding for the detector in this arrangement. The solution depends upon the mosaics and thicknesses of the crystals; it is 0.4% at 1 Mev for diffraction from the (211) planes of two calcite crystals, each 23 mm thick and of 1.7- and 0.9-second mosaics, respectively. The range of measurement extends from 80 kev to greater than 5 Mev. Where other values of γ -ray energies exist, agreement to within the expected precision, $\pm 0.2\%$ is obtained. The counting efficiency as a function of energy depends on the integrated reflectivities of the crystals which may be determined at the time of a γ -ray measurement by means of the double crystal arrangement. The integrated reflectivity as a function of energy has been calculated for a number of crystals of known mosaic and throughout the range of measurement, from 0.2 to 5 Mev, good agreement is obtained. (auth)

9963

LOCAL X-RAY SPECTROSCOPY. I. B. Borovskii and S. A. Ditsman (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). *Doklady Akad. Nauk S.S.S.R.* **124**, 1042-4(1959) Feb. 11. (In Russian)

Descriptions are given of the design and performance of a microfocusing x-ray spectrograph for studying condensed-system electron energy spectra. (R.V.J.)

9964

A PROJECTION MICROSCOPE FOR NEUTRON DOSIMETRY. G. E. Wilcox (Univ. of California, Livermore). *Health Phys.* **1**, 355-6(1958) Dec.

The design of an apparatus to interpret nuclear track film for determining neutron exposures is described. The design is a projection-type microscope, the use of which is described. (J.R.D.)

9965

A MACHINE FOR THE AUTOMATIC CHROMATOGRAPHY AND ASSAY OF MIXTURES OF RADIOACTIVE SUBSTANCES. M. C. Corfield, S. Dilworth, J. C. Fletcher, and R. Gibson (Wool Industries Research Assn., Torridon, Headingley, Leeds, Eng.) *Intern. J. Appl. Radiation and Isotopes* **5**, 42-50(1959) Feb.

The construction and operation of a machine, used for the automatic chromatography and estimation of mixtures of radioactive substances, are described. The apparatus is designed to collect effluent fractions of equal volume from a chromatographic column, evaporate them to dryness, count them in turn beneath an end window G-M counter and provide a record of the counts obtained. Some typical results are given, and the performance and versatility of the machine are discussed. (auth)

9966

AUTOMATIC ELECTRONIC INSPECTION OF MANUFACTURED SYSTEMS USING RADIOACTIVE COMPONENTS. G. G. Eichholz, C. M. Lapointe, and G. E. Alexander (Dept. of Mines and Technical Surveys, Ottawa). *Intern. J. Appl. Radiation and Isotopes* **5**, 51-6(1959) Feb.

An electronic system has been developed for the continuous inspection of small manufactured articles for the presence or absence of a vital part, in the case described the gas check ball of a certain type of ammunition primer. The critical part is tagged with a radioactive isotope, silver-110, and the assembled unit

is passed on a conveyor belt under a scintillation detector. If the detector sees the part in question it operates a mechanical gate which deflects the inspected unit. Some details are given of the electronic circuits, which employ transistors throughout, of the plating procedure used, and radiation health considerations. (auth)

9967

BETA-GAMMA IONISATION CHAMBER. J. J. Engelmann and B. Grinberg (Centre d'Etudes Nucleaires, Saclay, France). *Intern. J. Appl. Radiation and Isotopes* **5**, 63-6(1959) Feb. (In French)

The design is described of an ionization chamber which was found especially convenient for medical purposes. It was used for measurement of the specific activity of β -emitter solutions above $50 \mu\text{C}/\text{cm}^3$, measurement of γ emitters above 1 mc, and dose control at the surface of β applicators used for therapy. (C.H.)

9968

A SIMPLE APPARATUS FOR THE PRODUCTION OF RADIATION-INDUCED MUTATIONS IN SEED. J. K. Basson (Council for Scientific and Industrial Research, Pretoria). *Intern. J. Appl. Radiation and Isotopes* **5**, 69-71(1959) Feb.

A simple apparatus was designed and built for use in exposing seed to cobalt-60 gamma rays. The apparatus consists of a drum of about 25 cm diameter and 25 cm length with a re-entrant tube in the center which holds a 1 c strength cobalt-60 source. The source is placed in position after the cylinder is filled with seed, and the whole drum is then rotated to ensure a uniform dose distribution. (C.H.)

9969

ELECTRON BEAM DENSITY PROBE FOR MEASUREMENTS IN RAREFIED GAS FLOWS. F. C. Hurlbut (Univ. of California, Berkeley). *J. Appl. Phys.* **30**, 273-9(1959) Mar.

An instrument is described for the determination of densities in rarefied gas streams which utilizes the attenuation of an electron beam. The electron beam in passage through a rarefied gas becomes scattered in a number of elastic and inelastic processes and decays to a fraction of its initial intensity in the distance of a few electron mean free paths. Where the optical aperture of the detector is suitably small, the familiar linear absorption law applies. The mass absorption coefficient in this case is higher and more favorable for work at the lowest test section densities than in other absorption techniques investigated to the present. The instrument was used in an investigation of air flows about a sphere and a wedge and in the undisturbed stream. The flow was maintained constant for all portions of the test at Mach 1.95, Re/in. ~ 200 , test section static pressure $\sim 80 \mu\text{Hg}$. Plots of the original and the reduced data show adequate internal consistency and a qualitative conformity with expected configurations. (auth)

9970

ROLE OF SPECTROSCOPY IN THERMONUCLEAR RESEARCH. J. R. McNally, Jr. (Oak Ridge National Lab., Tenn.). *J. Opt. Soc. Am.* **49**, 328-37(1959) Apr.

The role of spectroscopy in thermonuclear research is reviewed briefly. The various techniques of observation and interpretation of spectra and some of the limitations are illustrated by appropriate tables and figures. It is shown that the spectroscopist has avail-

able a unique, multipurpose, and yet unperturbing probe which can contribute significantly to the interpretation of the pressing problems besetting thermonuclear scientists. (auth)

9971

DIFFUSION EFFECTS IN THE TRANSPIRATION METHOD OF VAPOR PRESSURE MEASUREMENT. Ulrich Merten (General Atomic Div., General Dynamics Corp., San Diego, Calif.). *J. Phys. Chem.* **63**, 443-5 (1959) Mar.

A correction is suggested for vapor pressure measurements by the transpiration method. (T.R.H.)

9972

PHOTOMULTIPLIER WINDOW FOR A LIQUID SCINTILLATOR. R. M. Tennent (Univ. of Leeds, Eng.). *J. Sci. Instr.* **36**, 148 (1959) Mar.

A liquid-tight window has been made in such a way that the photomultiplier can project into the scintillator. This type of window is an advantage for large tanks because all portions of the scintillator can be seen. (J.H.M.)

9973

FLUORIMETER FOR QUANTITATIVE DETERMINATION OF URANIUM. Gyorgy Mathe and Sandor Szalay. *Magyar Fiz. Folyóirat* **5**, 247-50 (1957). (Translated from *Refrat. Zhur. Fiz.* No. 10, 1958, Abstract No. 24164)

A description is given of a photoelectric fluorimeter used for the determination of uranium. The procedure used for small amounts of uranium (up to 10^{-10} grams) is described. The specimens are made from NaF fluxes. (J.S.R.)

9974

DOSIMETRY AND RADIOLOGICAL PROTECTION WITH A NEW UNIVERSAL PROTECTION DOSIMETER. A. Giliardini and A. Taccani. *Minerva nucleare* **2**, 389-92 (1958) Dec. (In Italian)

The physical characteristics of a new dosimeter are presented. In addition to the traditional dosimetric applications, the instrument permits other types of measurements, such as measurement of the x-ray output of diagnostic apparatus, measurement of radioactive preparations, measurement of both individual and collective dosages, determination of the dose received during therapeutic treatments, the simultaneous determination of the dose received at various points of a phantom during kinetic irradiations, and the detection of cosmic radiation or radioactive contamination. (tr-auth)

9975

MEASURING DEVICE. G. F. Haliday and S. Jefferson (to Bristol Aero-Engines, Ltd.). British Patent 798,902. *Nuclear Eng.* **4**, 146 (1959) Mar.

The device consists of a radioactive source emitting beta rays, a detector responsive to the intensity of the beta rays set at a fixed distance from the source, and means for masking the detector from the source. The mask is arranged in such a manner that the relative displacement between two components, e.g., two parts on a shaft changes the beam intensity and allows measurement of the torque or torsional strain as the twist in the shaft increases or is reduced.

9976

ELECTRONIC VALVE AMPLIFIER. L. B. Mullett (to U. K. Atomic Energy Authority). British Patent 799,140. *Nuclear Eng.* **4**, 146 (1959) Mar.

The amplifier is based on the multipactor effect, a phenomenon experienced with surfaces whose secondary emission coefficient can be greater than one. A multipactor oscillator is described in U.S.P. 2,674,694. The structure includes two parallel plates to support an RF electric field and to generate electrons by the multipactor effect. One of the plates is perforated and an anode placed beyond the perforated plate collects those bunches of electrons which pass through the perforations. RF power is fed into the space between the plates and extracted from the electron interaction space between the cathode and anode structures. In a double coaxial line the inner line may provide the multipactor space, a perforated outer conductor may then constitute the inner conductor of the outer line wherein interaction takes place. The amplifier may alternatively be a double ridge-loaded waveguide. The spaces may be resonant cavities.

9977

MEASURING APPARATUS FOR IONIZING RADIATIONS. (To Assoc. des Ouvriers en Instruments de Précision (A.O.I.P.) (France).) British Patent 799,151. *Nuclear Eng.* **4**, 146 (1959) Mar.

A resistance of high value and an electrometer are connected in series to a charged condenser. The two electrodes connected across the terminals of the electrometer are arranged in a closed chamber forming an ionization chamber. One of the electrodes is connected to the wall of the chamber while the other electrode is insulated. For measuring low-intensity fields, a Geiger-Mueller counter may be used and the two electrodes of this counter then connected to the electrodes of the electrometer.

9978

ELECTROMAGNETIC PUMPS. D. A. Watt (to U. K. Atomic Energy Authority). British Patent 799,546. *Nuclear Eng.* **4**, 146 (1959) Mar.

A static return conductor arrangement to obtain complete compensation for the end effects (armature reaction) is described. The return conductor is profiled to correspond to the significant limit of the current flow in the fluid duct when viewed in the direction of the magnetic field. Its thickness is varied so that the current distribution is similar to that in the liquid being pumped and in the duct.

9979

SPARK RECORDERS. J. Pickup (to U. K. Atomic Energy Authority). British Patent 799,641. *Nuclear Eng.* **4**, 146 (1959) Mar.

A spark between an indicating needle (e.g., of a microammeter) and a contact element may not only be required to record on paper the position of the needle at any time but also to operate automatically a visible or audible alarm or a controlling mechanism when the meter needle assumes a predetermined position. One solution of the problem is described in B.P. 708,110. A simpler arrangement is obtained with a contact element divided into two segments to provide alternative paths for the spark discharge current and varying the effective position of the division.

9980

STATISTICAL DESIGN BASIS FOR FAST SCALING SYSTEMS. A. W. Pryor and A. G. Klein (Australian Atomic Energy Commission). *Nuclear Instr. & Methods* **4**, 1-4 (1959) Jan.

Considerations of the statistics of random pulses show that design criteria of fast scalers for nuclear

particle detection are essentially different from those of equipment intended for operation with regularly spaced pulses. The regularizing action of scalers on random pulses is discussed and conclusions relating to practical systems are given. (auth)

9981

EXPERIMENTAL METHODS FOR THE STUDY OF NEUTRON CAPTURE GAMMA RAYS. Gunnar Bäckström (Inst. of Physics, Uppsala). Nuclear Instr. & Methods 4, 5-25(1959) Jan.

The methods for the determination of energies and intensities of neutron capture gamma rays are reviewed. Special attention has been given to the comparison of various types of instruments that have been or may be used in such studies. The problem of establishing decay schemes is discussed, as well as the possibilities of assigning spins and parities to the levels. Methods of determining multipolarities and lifetimes of transitions are also included. (auth)

9982

9-INCH LIQUID HYDROGEN BUBBLE CHAMBER IN A PULSED MAGNETIC FIELD. D. C. Colley, J. B. Kinson, and L. Riddiford (Univ. of Birmingham, Eng.). Nuclear Instr. & Methods 4, 26-9(1959) Jan.

The construction and operation of a liquid hydrogen bubble chamber nine inches in diameter are described. It is expanded in the liquid phase by a stainless steel bellows and the construction is such that it may be used in an intense pulsed magnetic field. The latter is provided by an air-cored solenoid. (auth)

9983

AN ENERGY SENSITIVE ČERENKOV DETECTOR WITH IMPROVED OPTICAL FOCUSING. M. Huq and G. W. Hutchinson (Univ. of Birmingham, Eng.). Nuclear Instr. & Methods 4, 30-5(1959) Jan.

A Cherenkov detector is described having improved energy selecting properties for protons of energy about 900 Mev. Good focussing from an extended area of a spherical reflecting surface has been realized by minimizing astigmatism in the optical system. The light is produced in a liquid radiator and detected by photomultipliers used in coincidence. The energy resolution is largely determined by the dimensions of the optical stop used. It is about $\pm 4\%$ in the instrument constructed. (auth)

9984

ACCURATE MAGNETIC FIELD AND FIELD GRADIENT MEASURING INSTRUMENT FOR DYNAMIC LOW FIELDS IN A SYNCHROTRON MAGNET. Hans M. Nysäter (Harvard Univ., Cambridge, Mass. and Massachusetts Inst. of Tech., Cambridge). Nuclear Instr. & Methods 4, 44-9(1959) Jan.

Two biased peaking strips have been combined into a differential magnetic probe. The pulses from the two peaking strips are displayed on an oscilloscope screen with a time separation, for the same bias field, given by the field difference between the locations of the two strips. At the bias current corresponding to the chosen field level, the two peaking strips are given slightly different bias, so as to cancel the time lag between pulses. The field difference is read directly as a d-c current. The magnetic field itself is measured with one of the peaking strips, as its d-c bias current. With careful calibration, the accuracy in gradient divided by field (n -value) was estimated to be of the order of 1% in a nearly linear synchrotron field of 25 gauss, varying

by 4 percent per cm and 0.15 gauss/ μ s. The instrument, when applied to the CEA magnets, confirmed the feasibility of an injection field as low as 25 gauss, although at the magnet ends sharp peaks occur in the field and gradient distributions, apparently a remanent field contribution. (auth)

9985

AN ABSORBER SYSTEM FOR SCATTERING EXPERIMENTS. W. J. O'Neill, E. Sundahl, and H. Ostrander (Argonne National Lab., Lemont, Ill.). Nuclear Instr. & Methods 4, 50-1(1959) Jan.

A device is described which permits changing absorber thickness in scattering experiments remotely and accurately. Absorber stack disks are rotated by three direct-drive a-c motor systems which provide accurate stable positioning of each of the disks. (T.R.H.)

9986

INSTRUMENT FOR THE MEASUREMENT OF THE AIR CONTAMINATION CAUSED BY VERY FINE DUST CONTAINING URANIUM, INSENSITIVE TO THE RADIOACTIVITY OF THE AIR. C. Cottini, E. Gatti, and A. Malvicini (Laboratori CISE, Milan). Nuovo cimento (10) 9, Suppl. No. 2, 381-4(1958). (In Italian)

A description is given of an air monitor which is used to determine air contamination caused by dust containing uranium and which is sensitive to a concentration lower than the maximum permissible dose for professional personnel. The monitor consists of an aluminum strip which passes continuously across an electrostatic precipitator and between two ZnS scintillators. The aluminum ribbon absorbs almost all the alpha particles of uranium and about 40% of the alphas from RaC' (which represents almost all the activity caused by radon decay products). The detectors are connected to a differential frequency meter sensitive only to the difference of the impulse frequencies of the two detectors. A schematic diagram of the frequency meter is given. (J.S.R.)

9987

BUBBLE CHAMBER DETECTOR OF WEAK RADIOACTIVITY. G. Brautti and M. Ceschia (Univ. of Trieste and Istituto Nazionale di Fisica Nucleare, Trieste) and P. Bassi (Univ. of Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10) 10, 1148-9(1958) Dec. 16.

A bubble chamber detector for very weak radioactivity is described in which boiling frequency gives a measurement of the ionizing radiation intensity. Some preliminary measurements are reported giving indications of the sensitivity of the apparatus to protons and β and α particles. (A.C.)

9988

GRAIN SIZE AND GRAIN DENSITY IN ILFORD K-5 AND L-4 EMULSIONS. R. C. Kumar (National Research Council, Ottawa). Nuovo cimento (10) 11, 108-10(1959) Jan. 1.

Electron micrographs of grains in unprocessed and processed Ilford K-5 and L-4 emulsions are shown. The silver bromide grain sizes in the unprocessed K-5 and L-4 plates were measured and found to be normally distributed with mean values of $(0.210 \pm 0.007) \mu\text{m}$ and $(0.134 \pm 0.004) \mu\text{m}$ and standard deviations of $0.035 \mu\text{m}$ and $0.021 \mu\text{m}$, respectively. The electron micrographs of the silver grains in processed emulsions reveal absence of spherical shape or solid structure in case of most of these grains. The grain densities on plateau

ionization tracks have been found to be approximately the same in K-5 and L-4 plates as in G-5 plates processed under similar conditions. The L-4 plates however are subject to more serious fading with delay in processing after exposure than the K-5 or G-5 ones. (auth)

5985

A NEW TYPE OF PARTICLE DETECTOR: THE "DISCHARGE CHAMBER." S. Fukui and S. Miyamoto (Osaka Univ.). *Nuovo cimento* (10) **11**, 113-15(1959) Jan. 1.

The possibility of constructing a new type of particle detector based on gaseous discharge is described. This detector secures the precision of the trajectory of the particle and works for groups of particles. (A.C.)

5990

A γ -RADIATION INDICATOR WITHOUT HEATER CURRENT OF THE RELAY TYPE. A. I. Aronov and C. Kh. Novik. *Priboirostroenie* No. 6, 28-9(1958).

In the newly developed indicator, a thyatron (with cold cathode) is used in combination with a Geiger counter. The Geiger counter is used in the range of the "middle current." The control grid of the thyatron working without a heater current is connected to the R-C member to be integrated. If no γ radiation impinges upon the counting tube, there will be no current in the load resistance. If, however, the counting tube is irradiated, the middle current in the load chain increases, and, accordingly, the potential at the control electrode and the current in the control circuit are likewise increased. If the current in the control circuit attains the amount of the extinguishing voltage of the thyatron, there is no more ignition, and the current flows in the anode-cathode circuit. The relay connected in this circuit begins to operate. This apparatus was produced in the laboratory and the necessary technical data are given. With a pulse number of 150 to 200 pulses per second at the Geiger counter the apparatus operated satisfactorily. The dependence between the activity of the source A in mc and the distance R between the source and the counting tube can be expressed by the formula: $A = 3R^2$. (TCO)

5991

PULSE SPREAD IN PROPORTIONAL COUNTERS. S. Ramakrishna (Indian Inst. of Science, Bangalore). *Proc. Indian Acad. Sci. Sec. A* **49**, 25-30(1959) Jan.

A study of the spread in pulse height in proportional counters with different counter geometries was made. It was shown that the spread is of the order of 30%. This spread due to deviation from cylindrical geometry does not present a serious difficulty for discrimination of particles of sufficiently different energies. (auth)

5992

CONSTRUCTION AND CHARACTERISTICS OF GLASS WINDOW COUNTERS FOR THE DETECTION OF BETA AND GAMMA RAYS. Raquel Peñalosa. *Rev. mex. fis.* **7**, 111-16(1958). (In Spanish)

A special form of window counter was produced in order to provide a highly sensitive detector for beta and gamma radiation. A method was developed for obtaining thin (0.35 mm) and very regular windows in the glass. Characteristics of the counter as well as manufacturing methods are shown. (auth)

5993

VERNIER CHRONOTRON. Harlan W. Lefevre and James T. Russell (General Electric Co., Richland, Wash.). *Rev. Sci. Instr.* **30**, 159-66(1959) Mar.

The instrument described is a multichannel time interval analyzer with digital output for use in the millimicrosecond region. The analyzer consists of two circulating transmission lines with a single fast coincidence circuit between them and associated gating circuits. Each circulating line is a precisely trimmed coaxial cable with its ends joined by a two-stage noninverting saturating amplifier. A circulating pulse delivers time marks to the input of the coincidence circuit. By making the circulation periods of the two lines slightly different, the time marks are made to arrive at slightly different frequencies. The instrument is a true vernier. To measure an interval it is only necessary to count the number of circulations before coincidence and multiply by the difference in circulation period of the lines. A commercial 256-channel magnetic core memory is used for storage. The circuit of the instrument is described. A method is described for predicting circulation threshold, growth to equilibrium, and equilibrium amplitude of a circulating pulse from the amplifier transfer characteristic. Data are presented which indicate the linearity, stability, and time resolution of the instrument. (auth)

5994

HIGH POWER VACUUM SPARK GAP. D. C. Hagerman and A. H. Williams (Los Alamos Scientific Lab., N. Mex.). *Rev. Sci. Instr.* **30**, 182-3(1959) Mar.

The design and construction of a voltage graded vacuum spark gap are described. This gap is capable of switching currents as large as 10^4 amp at voltages up to 75 kv. The effect of the insulating walls of the gap is briefly discussed. (auth)

5995

SELF-EXCITED 150-KILOVOLT RESONANT CAVITY FOR OPERATION AT 87 MEGACYCLES. H. E. Jackson, R. L. Martin, and J. Waggoner (Cornell Univ., Ithaca, N. Y.). *Rev. Sci. Instr.* **30**, 187-90(1959) Mar.

A high-voltage, fixed frequency re-entrant cavity of moderate power requirements designed for use in the Cornell 1.5-Bev synchrotron is described. Design considerations and details of the cavity gap structure are presented. The problem of multipactoring is described. Advantages of coaxial gap construction using an internal insulator are given. In particular a d-c bias to prevent multipactoring can easily be applied. A simplified analysis of the operation of the cavity in terms of equivalent circuits is also given. (auth)

5996

HIGH-Q STARK CAVITY ABSORPTION CELL FOR MICROWAVE SPECTROMETERS. A. Dymanus (Fysisch Laboratorium der Rijksuniversiteit, Utrecht). *Rev. Sci. Instr.* **30**, 191-5(1959) Mar.

Design considerations, description, and some data on the performance are given of a large pillbox-shaped Stark cavity absorption cell for the 1.25-cm wavelength region. The cavity can be used in any TE_{m1} mode with m ranging from about 5 to about 12 and its most prominent features are: high loaded Q factor ($\sim 5 \times 10^3 - 10^4$), good electric insulation (at pressures below 4×10^{-2} mm Hg Stark voltages up to 3000 v can be applied), low Stark field inhomogeneity (diameter to length ratio 15-20), large band width (from about 18 to about 28 kMc), and low mode density. No cross-mode resonances occur and the only undesired modes excited appreciably are the TE_{2m1} ones. When used in transmission only the TE_{m1} modes couple to the output. The cavity can be used at the same time as a reference cavity of a Pound-type klystron frequency stabilizer. The klystron frequency will then automatically follow the resonance frequency

of the cavity over a frequency interval up to 400 Mc. (auth)

9997

PRECISION CHUCK AND CHIP CATCHER FOR SECTIONING DIFFUSION SAMPLES. S. J. Rothman and L. J. Sobocki (Argonne National Lab., Lemont, Ill.). *Rev. Sci. Instr.* 30, 201-2(1959) Mar.

A chuck designed for sectioning uranium diffusion specimens is described which facilitates exact alignment of the specimen face to the lathe axis. A lucite chip catcher is also described. (A.C.)

9998

MERCURY-GLASS CHECK VALVES. Hilton A. Smith, J. C. Posey, and C. O. Thomas (Univ. of Tennessee, Knoxville). *Rev. Sci. Instr.* 30, 202-3(1959) Mar.

A mercury-glass check valve is described for maintaining constant pressure in a system during gas evolution. (A.C.)

9999

SIMPLE ZERO FIELD INDICATOR FOR BETATRONS. R. R. Gabriel, E. L. Garwin, and A. S. Penfold (Univ. of Chicago). *Rev. Sci. Instr.* 30, 203(1959) Mar.

A "peaking strip" is described which, when placed across the poles of a betatron, produces a sharp pulse whenever the magnetic field passes through zero. (A.C.)

10000

ATTENUATION LENGTH IN FILAMENT SCINTILLATORS. Roy M. Weinstein and Hale V. Bradt (Massachusetts Inst. of Tech., Cambridge). *Rev. Sci. Instr.* 30, 206-7(1959) Mar.

Measurements were made of the attenuation of filament scintillators. Filaments of from 1- to $\frac{1}{2}$ -mm diameter were checked. The results of the tests indicate that the attenuation of light intensity follows an exponential law. Results for the 1-mm filament are graphically shown. (A.C.)

10001

CONTROL UNIT FOR USE IN THE AUTOMATIC NORMALIZATION OF FOIL COUNTING. Laurence S. Beller (Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.). *Rev. Sci. Instr.* 30, 207-8(1959) Mar.

A control unit for use in the automatic normalization of foil counting is described which requires no modification of commercial equipment. The system can be used either for automatic normalization or fixed-time-interval counting. (A.C.)

10002

A SIMPLE GAMMA SPECTROMETER FOR THE DECREASE OF THE PERTURBATION PULSES IN THE MEASUREMENT OF I^{131} . Erich Oberhausen and Richard Schüssler (Univ. of Saarlandes, Homburg, Ger.). *Strahlentherapie* 108, 301-5(1959) Feb. (In German)

The authors describe an apparatus which permits the separation of the electron-multiplier impulses in iodine measurements by their height. The isolation is done by means of a simple connection with two univibrators and a control-tube. The apparatus contains an additive stage, so that measuring may be done with several electron-multipliers simultaneously. An integration device serves for direct indication. (auth)

10003

DEVELOPMENT IN NUCLEAR HANDLING EQUIPMENT. W. J. Dollard (Westinghouse Electric Corp., East Pitts-

burgh, Penna.). 6p. in "Advances in Materials Handling." New York, The American Society of Mechanical Engineers, 1958. 116p.

The handling of fuel elements of a pressurized-water reactor by remote means is presented. Remote-handling equipment for homogeneous reactors is also discussed. (W.L.H.)

10004

HANDLING PROBLEMS WITH RADIOACTIVE MATERIALS. Frank Ring, Jr. (Oak Ridge National Lab., Tenn.). 10p. in "Advances in Materials Handling." New York, The American Society of Mechanical Engineers, 1958. 116p.

Various types of remote-control equipment are discussed for storage, packaging, and shipping of radioactive materials. (W.L.H.)

METALLURGY AND CERAMICS

10005 AERE-I/M-38

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

PREPARATION OF THICK ZIRCONIUM-TRITIUM AND ZIRCONIUM-DEUTERIUM TARGETS. C. Evans. Sept. 26, 1955. 6p.

The production of thick zirconium-tritium or zirconium-deuterium targets, on tungsten backings, is described. Those prepared using 0.002 in. thick zirconium foil and approximately 14 milligrams per target have an atomic ratio of hydrogen isotope to zirconium consistently greater than 1:1, the maximum attained being 1.5:1. Using 0.0005 in. thick zirconium and 7 milligrams/target, although the maximum ratio is still 1.5:1, the usual ratio is between 0.5:1 and 1:1. (auth)

10006 AERE-M/TN-21

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

INTERMETALLIC FORCES IN LIQUID ALLOYS. B. R. T. Frost. July 1953. 15p.

The problem of the changes in structure and physical properties which occur when alloys melt is discussed. From a review of published data on this subject, it is concluded that the inter-atomic forces which give rise to compound formation in the solid state are also satisfied in the disordered liquid structure. Suggestions are made for the systematic examination of a series of magnesium alloys to determine the effect of the electrochemical factor on the physical properties of liquid alloys. (L.T.W.)

10007 ANL-5927

Argonne National Lab., Lemont, Ill.

CORROSION RESISTANCE AND MECHANICAL PROPERTIES OF ALUMINUM POWDER PRODUCTS. J. E. Draley and W. E. Ruther. Mar. 1959. 10p. Contract W-31-109-eng-38. \$0.50(OTS).

Experimental extrusions were prepared from mixtures of atomized aluminum alloy and several powdered additives, including SiO_2 , AlPO_4 , and Al_2O_3 . Some of the extrusions failed during corrosion testing in water at 290 and 350°C. Others corroded in approximately the same fashion as wrought X8001 alloy. The ultimate tensile strengths of these extrusions at 316°C were approximately two and one-half times greater than that of wrought X8001 alloy. (auth)

10008 APAE-Memo-175

Alco Products, Inc., Schenectady, N. Y.
ROLLING AND WELDING TYPE 430M TUBES TO STAINLESS STEEL OVERLAIN CARBON STEEL TUBE-SHEETS. SM-1 (APPR-1) RESEARCH AND DEVELOPMENT PROGRAM. Task No. X. R. W. Bennett, R. P. Meister, and R. J. Kerton. Feb. 16, 1959. 60p. Contract AT(30-3)-326. \$9.30(ph), \$3.60(mf) OTS.

In the fabrication of the steam generator on APPR-1A it was considered necessary to roll the Type 430M tubes into carbon steel tubesheets to ASTM Specification A350-Grade LF-1, modified with 1.66% nickel; and weld the tube ends to the stainless steel overlay previously applied to the tubesheet. The rolled joint was a necessary precaution to prevent secondary water, that might contain chlorides, from contacting the stainless steel weld joining the tubes to the tubesheets. The welded joint provided the mechanical strength for attaching the tubes to the tubesheets. A laboratory program was conducted, therefore, to develop practicable procedures for welding the Type 430M tubes to the stainless steel overlay; as well as to assure that the tubes could satisfactorily be rolled to the tubesheets. Automatic and manual tungsten-arc welding procedures were developed that were capable of consistently providing an austenitic weld having a strength exceeding that of the heat affected zone or the unaffected tube itself. Type 430M tubes in the as-received, and softened conditions were rolled into prototype test units under various conditions of rolling. It was concluded that the Type 430M tubes in the as-received condition could be satisfactorily rolled into the A350-Grade LF-1 tubesheet and be tight to a pressurized helium leak test. To translate the laboratory procedures into fabrication practice for the steam generator consisting of the same materials, detailed welding and rolling procedures were outlined and transmitted to the fabricator, as well as included in this report. (auth)

10009 BMI-1326

Battelle Memorial Inst., Columbus, Ohio.
HIGH-TEMPERATURE MECHANICAL PROPERTIES OF TANTALUM. David C. Drennen, M. Eugene Langston, Charles J. Slunder, and Joseph G. Dunleavy. Mar. 2, 1959. 33p. Contract W-7405-eng-92. \$1.00 (OTS).

Creep and creep-rupture tests were performed at 1200°F in the helium on arc-cast and on sintered rolled tantalum sheet to investigate the effect of structure and gaseous contamination on the creep resistance of tantalum. A vacuum-induction furnace was developed for annealing and for degassing the as-received cold-worked material. The tests were conducted with inert-atmosphere resistance creep furnaces designed to prevent excessive interstitial-element pickup. The effect of hydrogen, nitrogen, and oxygen on the high-temperature strength of tantalum was not clearly discernible. Degassing of annealed sintered tantalum in flowing sodium produced in a lower oxygen contamination, but had no significant effect on creep resistance. The method of manufacture, the grain size, and the treatments performed on the material, on the other hand, produced a substantial effect on creep resistance. Annealed arc-cast tantalum possessed somewhat higher creep resistance at 1200°F than did annealed sintered tantalum. The highest creep resistance was found in a fine-grained sintered material which had been degassed 20 to 60 min at 4500 to 4650°F, cold rolled to an 80% reduction, and then recrystallized 10 to 15 min at about 2800°F prior to creep testing. The lowest creep resistance was noted

for an extremely coarse-grained thermally degassed material. (auth)

10010 CF-58-12-65

Oak Ridge National Lab., Tenn.
EXAMINATION OF Zr AND Ti RECOMBINER LOOP SPECIMENS. P. L. Rittenhouse. Dec. 19, 1958. 16p. Contract [W-7405-eng-26]. \$3.30(ph), \$2.40(mf) OTS.

Cold-worked specimens of iodide zirconium, Zircaloy-2, iodide titanium, and A-55 titanium were tested in a high-pressure recombiner loop in an attempt to duplicate anomalous results obtained in a prior recombiner loop. Hydrogen analyses and metallographic examinations were made on all specimens. The titanium materials and Zircaloy-2 picked up major amounts of hydrogen in the cell section. None of the materials tested showed appreciable hydrogen absorption in the recombiner section. Complete recrystallization occurred in all cell specimens while only Zircaloy-2, of the recombiner specimens, showed any degree of recrystallization. No explanation for this behavior can be given. A summary of the data obtained in previous recombiner loops is compared with the results of this loop. Conclusions were based on the results of three recombiner loops. Primarily because of the hydrogen absorption data obtained in all three recombiner loops, it is recommended that the zirconium and titanium materials tested not be used in environments similar to those encountered in high pressure recombiner loops. (auth)

10011 CRCE-716(Pt. I)

Atomic Energy of Canada Ltd., Chalk River, Ont.
PREPARATION OF URANIUM DIOXIDE FOR USE IN CERAMIC FUELS. PART I. BATCH PRECIPITATION OF AMMONIUM DIURANATE. W. T. Bourns and L. C. Watson. Sept. 1958. 30p. (AECL-757). \$1.00(AECL).

Experiments were made to determine a suitable method for making ammonium diuranate (ADU) which could be reduced in hydrogen to give a readily sinterable UO_2 . The factors in precipitation with ammonium hydroxide which tended to give a readily sinterable powder were high ammonium hydroxide concentration, high temperature, high pH, and relatively fast addition of the hydroxide to the uranyl nitrate solution. Precipitation with gaseous ammonia gave a readily sinterable material under almost all conditions, but the UO_2 produced had to be sintered at a slower rate to prevent breaking of the pellets during sintering. Simple tap-density and Blaine air-permeability tests made on either the ammonium diuranate or the uranium dioxide gave an indication of the sinterability of the material. Precipitation conditions are specified for production of ammonium diuranate powder, which when reduced, pressed and sintered, will give a sintered density above 10.4 g/cm³ (95% of theoretical). (auth)

10012 CRCE-716(Pt. II)

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
PREPARATION OF UO_2 FOR USE IN CERAMIC FUELS. PART II. CONTINUOUS PRECIPITATION OF AMMONIUM DIURANATE. E. Yatabe and L. C. Watson. June 1958. 21p. (AECL-662). \$0.50(AECL).

A study was made of the optimum conditions for the continuous precipitation of ammonium diuranate suitable for the preparation of uranium dioxide of high sintered density. With uranyl nitrate solutions at a concentration of 100 g U/l and aqueous ammonia as reactants, ammonium diuranate precipitated at 60°C at pH above 6.8

consistently yielded uranium dioxide which could be sintered to a density of 10.3 to 10.7 g/cc. As the precipitation pH was increased above 6.8, the ADU became more difficult to filter. Considering both the ease of filtration of the ADU and the sinterability of the UO_2 , it is desirable to precipitate the ADU at a pH between 7.0 and 7.5. (auth)

10013 D2-3285

Boeing Airplane Co., Seattle.

BIBLIOGRAPHY OF HIGH TEMPERATURE MATERIALS. Layton L. Kimmel. Jan. 1959. 18p.

A literature survey of Nuclear Science Abstracts from 1950 through June 9, 1958, was conducted for information on high-temperature materials such as alloys, ceramics, coatings, and graphite. (auth)

10014 DL(S)/TN-2023

Gt. Brit. Springfields Works, Springfields, Lancs, England.

CORROSION OF ALUMINIUM ON THE AUTOCLAVES. L. Bourne. Feb. 25, 1952. 10p.

The corrosion of aluminum in the autoclave in relation to the brazing of cans was investigated, and methods of preventing the corrosion were developed. Aluminum cans, heated to temperatures in the range 550 to 620°C and cooled in air or water, corrode rapidly during the autoclave test. The rate of corrosion is increased if the cans are pickled in phosphoric acid. The amount of corrosion may be reduced by furnace cooling and can be prevented by covering the cans with a layer of zinc or grease. The zinc coating can be removed by pickling the cans in nitric acid and then in phosphoric acid. The grease layer could be removed by any of the standard methods. The Mark III cans are rather more susceptible to corrosion than the Mark II cans. Normal brazing procedure does not usually induce this phenomenon but, if heating has been excessive, it may occur. (auth)

10015 DMIC-108

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

WELDING AND BRAZING OF MOLYBDENUM. N. E. Weare and R. E. Monroe. Mar. 1, 1959. 44p. Contract AF18(600)-1375. (AD-210486; PB-151063).

Available information on the welding and brazing of molybdenum as it applies to joining structural components is summarized. The metallurgical considerations involved in joining molybdenum are discussed, as well as testing, cleaning, and joining procedures. A survey of published literature revealed considerable information of value to designers and materials and process engineers, although only a limited amount of this information has been reported as standardized engineering data. (auth)

10016 DMIC-109

Battelle Memorial Inst., Defense Metals Information Center, Columbus, Ohio.

COATINGS FOR PROTECTING MOLYBDENUM FROM OXIDATION AT ELEVATED TEMPERATURE. E. S. Bartlett, H. R. Ogden, and R. I. Jaffee. Mar. 6, 1959. 43p. Contract AF18(600)-1375. (AD-210978; PB-151064).

Coatings that have been developed for protecting molybdenum from oxidation are described, and their protective capabilities discussed. The suitability of the various coatings is dependent upon the anticipated application. Protective coatings are considered from two points of view—the coating system and the method of application of the coating to the molybdenum base. Sys-

tems discussed include chromium, silicon, nickel, precious metals, ceramic materials, and refractory oxides. Methods of application are electroplating, flame spraying, vapor deposition, cladding, enameling, and liquid-phase diffusion. Capabilities of various semicommercial coatings are compared in a very general manner. The results of a number of service tests on coated molybdenum parts are summarized. These include investigations of materials for potential use as jet-engine turbine buckets, nozzle vanes, thermocouple protection tubes, ramjet flame-holder gutters, pitot tubes, glass-bath electrodes, and glass-bath stirring rods. (auth)

10017 DP-357

Du Pont de Nemours (E. I.) & Co. Engineering Dept., Wilmington, Del. and Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.

70-TON SHIPPING CASK FOR THE SAVANNAH RIVER PLANT—DESIGN AND FABRICATION. William H. Piper and John W. Langhaar. Jan. 1959. 71p. Contract AT(07-2)-1. \$2.00(OTS).

Several casks externally finned for heat dissipation, with an internal length of 15 feet and weighing about 70 tons, were constructed for off-plant shipment of radioactive material. Basic safety considerations leading to the selection of this type of cask are discussed. Unusual design and fabrication problems, and operating experience with the casks, are described. The principal fabrication difficulties were maintaining the required dimensional tolerances in view of the large amount of welding and producing the desired degree of metallurgical bond between the lead fill and the steel box. Special techniques were developed by the vendor to overcome these difficulties. A "floating load" principle is used for attaching the cask to the railroad car, in order to avoid excessive stress from thermal expansion. Measurements of shielding effect and heat dissipation have agreed reasonably well with design values. (auth)

10018 HW-43831

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

INTERIM REPORT, FLANGING AND FLARING OF ZIRCONIUM AND ZIRCALOY-2 PROCESS TUBING. A. H. Hegge. June 20, 1956. 19p. Contract [W-31-109-Eng-52]. \$3.30(ph), \$2.40(mf) OTS.

This study was conducted to devise procedures for forming Van Stone flanges and flares on Zr and Zircaloy-2 tubing. Successful Van Stone flanges were formed on 55% cold-reduced Zircaloy-2 specimens which had received various anneals. Flares up to 60° could be rolled on this material after a 20 second salt bath or induction anneal. All unalloyed Zr tubing available was received in an annealed state and could be flanged with no additional treatment. (W.L.H.)

10019 HW-57161

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

BISMUTH SLURRIES AS REACTOR FUELS. H. T. Hahn. Aug. 15, 1958. 34p. Contract W-31-109-Eng-52. \$1.00(OTS).

Experimental work conducted at the Hanford Laboratories in the fissionable metal oxide-liquid metal slurry field is reported. Uranium has been used as stand-in for plutonium until systematics and techniques of handling slurries are established. The oxide was chosen as a suitably stable, readily available compound. Bismuth and the Bi-45% Pb eutectic have been employed as suspending media. The goal has been to

evaluate the practicality of the slurry system for inclusion in the Plutonium Recycle Program. (W.L.H.)

10020 HW-58764

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

EXPERIMENTAL TECHNIQUES FOR DETERMINING SURFACE ENERGIES OF SOLID METALS—A LITERATURE SURVEY. J. J. Laidler. Jan. 12, 1959. 8p. \$1.80(ph), \$1.80(mf) OTS.

This survey was initiated to facilitate the selection of an experimental technique for determining the surface tension of U in support of swelling studies of irradiated U. It is believed that swelling in U occurs due to the formation of small bubbles of fission gas (Kr and Xe), and the forces resisting the expansion of the bubbles are the elastic and plastic flow energies and surface tension of the metal. (W.L.H.)

10021 IGR-R/R-304

United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.

NIOBium DATA MANUAL. E. L. Francis, comp. 1958. 25p. \$1.12(BIS).

A compilation of the best available unclassified data on the physical, mechanical, and chemical properties of niobium is presented. A list of cited references is included. (J.R.D.)

10022 ISC-1029

Ames Lab., Ames, Iowa.

LIST OF HIGH PURITY METALS AVAILABLE FROM AMERICAN PRODUCERS. H. A. Wilhelm and R. E. McCarley. Dec. 19, 1958. 52p. Contract W-7405-eng-82. \$1.50(OTS).

A list of American producers of pure metals is presented. The purities are those stated by the producer. Some listings include grades of not exceptional purity; these may be of interest in research on alloys where that particular metal is a minor constituent. A toxicity code and price list are included; however, no notation of pyrophoricity is included. (J.R.D.)

10023 ISC-1058

Ames Lab., Ames, Iowa.

CREEP OF URANIUM. Donald R. Saxton and Glenn Murphy. June 1958. 36p. Contract W-7405-eng-82. \$6.30(ph), \$3.00(mf) OTS.

Many theories have been proposed to explain the mechanism of creep in metals. No theory has successfully predicted the behavior of all metals completely and accurately through the three stages of creep for all stresses and temperatures. The mechanism involved in the initial stage of creep is examined. Application of dimensional analysis to the experimental data obtained from creep tests of 26 natural uranium specimens yields an expression for the transient creep rate, in the ranges of stress and temperature investigated. The equation agrees well with experimental evidence for transient creep within the limits set forth and provides a good basis for further investigation in other ranges of stress and temperature. (auth)

10024 K-1404

Oak Ridge Gaseous Diffusion Plant, Tenn.

GRAPHITIZATION IN THE POWER STATION AT THE OAK RIDGE GASEOUS DIFFUSION PLANT. C. H. Mahoney and W. S. Dritt. Nov. 6, 1958. 40p. Contract W-7405-eng-26. \$6.30(ph), \$3.00(mf) OTS.

A review of the progress of graphitization in the carbon- $\frac{1}{2}\%$ molybdenum steel components of the Power

Station at the Oak Ridge Gaseous Diffusion Plant is presented, and of the rehabilitation measures taken to control it. All carbon-molybdenum components in the Number 3 Boiler portion of the system were studied following two failures under full load conditions of two forged reducers in the main steam piping system during September 1957. The information obtained in this study is included. (auth)

10025 KAPL-1915

Knolls Atomic Power Lab., Schenectady, N. Y.

THE DEVELOPMENT OF COMPOSITE CONTROL RODS FOR WATER-COOLED POWER REACTORS. W. E. Ray. Oct. 15, 1957. 36p. Contract W-31-109-Eng-52. \$1.25 OTS.

The phrase "composite control rod" is used to describe a hafnium-tipped titanium-boron control component with a titanium cladding. Blades for such control rods were successfully prepared in cooperation with the Battelle Memorial Institute by a picture-frame rolling technique. The rolling packs, which are machined from type 304 stainless steel, contain sintered titanium boron and wrought hafnium core materials in a commercially pure titanium envelope. Such packs are evacuated, sealed off, and rolled at 1600°F with a total reduction of 3/1 using 20% reduction per roll setting. Post-fabrication treatments include mechanical removal of the stainless steel envelope, flat annealing, machining, and stress relief annealing. Data on the mechanical properties, corrosion performance, thermal cycling resistance, and irradiation damage resistance of composite control rod components are presented. This information strongly indicates that composite control rods will perform satisfactorily in water-cooled reactors. (auth)

10026 KAPL-1952

Knolls Atomic Power Lab., Schenectady, N. Y.

IRRADIATION PERFORMANCE OF HIGHLY ENRICHED FUEL. C. E. Lacy and E. A. Leary., June 20, 1958. 24p. Contract W-31-109-Eng-52. \$1.00(OTS).

The theoretical aspects of the effect of irradiation on fuel materials are reviewed. These effects are then interpreted in terms of their engineering significance to fuel element performance. One of the most important irradiation effects is the resulting increase in fuel volume. The significant variables relative to fuel volume increase during irradiation include amount of fuel fissioned, temperature of irradiation, and fission rate. A method for reporting amount of fuel fissioned, which is applicable to all types of fuel systems, is presented. Data are presented that show the irradiation-induced volume change in zirconium-uranium alloy fuels as a function of irradiation variables. The nature of the relationships among the variables affecting fuel volume increase during irradiation are discussed. The irradiation-induced volume changes in the zirconium-uranium alloy system are compared with volume changes produced by postirradiation annealing. The irradiation data on zirconium-uranium alloys are compared with similar data on other enriched fuel systems. A specific comparison is made with the stainless steel- UO_2 dispersion fuel system. (auth)

10027 KAPL-M-DBK-5

Knolls Atomic Power Lab., Schenectady, N. Y.

EVALUATION OF THE TUNGSTEN-INERT GAS-ARC WELDING PROCESS FOR JOINING TYPE 6061T-6 ALUMINUM TUBING. D. B. Kittle. Aug. 20, 1958. 17p. Contract W-31-109-Eng-52. \$3.30(ph), \$2.40(mf) OTS.

The use of the tungsten inert-arc process for joining aluminum tubing was investigated. The welds were required to be leak tight, smooth, and metallurgically sound in relation to the base metal. The materials and procedures used are described. It was concluded that welds could be made to meet all the requirements except that drop-through on the inside surface exceeded the allowed 0.003 in. (J.R.D.)

10028 LA-2269

Los Alamos Scientific Lab., N. Mex.

THE THERMAL CONDUCTIVITY OF A MOLTEN Pu-Fe EUTECTIC (9.5 at. % Fe). John E. Deverall. July 1958. 59p. Contract W-7405-eng-36. \$1.75(OTS).

The thermal conductivity of the Pu-Fe eutectic mixture (9.5 at. % Fe) was measured in both the solid and liquid states by the use of a guarded cylinder apparatus which operated in a high vacuum. The apparatus was designed as an absolute measuring device and was checked with a known material. The thermal conductivity values obtained varied from 0.034 at 220°C to 0.042 at 400°C in the solid state and from 0.043 at 420°C to 0.046 at 520°C in the molten state, with the units of cal/cm sec °C. The curves appear to be linear with positive temperature coefficients for both phases. Results are estimated to be accurate to less than ±5%.

(auth)

10029 MAB-146-M

National Research Council. Materials Advisory Board. REPORT ON COMPOSITE STRUCTURAL MATERIALS. Dec. 18, 1958. 67p. Contract DA-36-039-sc-76436.

An evaluation of the high-temperature structural potential of the concept of combined materials and the formulation of directions future research should take to maximize the effective exploitation of the concept were undertaken for three categories of composite structural materials, namely, fine particle dispersions, strong brittle particles surrounded by layers of ductile metal, and fibrous reinforced composite materials. The potential of these types of composite structural material appears very good, but their success in important applications is uncertain or unpredictable. The last category is not so well developed at the first two, and the greatest potential of new ideas for research may be found here. The research areas which should be emphasized include scientific research along processing lines for fine particle dispersion systems, mechanisms and fundamentals for systems of brittle particles cemented with ductile metal, and the study of new systems and properties of fibrous reinforced composites. A total Government-sponsored research program of \$1,500,000.00 per year, for at least three years, is recommended as the minimum rate of effect for all three categories of composite structural materials. This represents about a 30% increase over the current program. (auth)

10030 NAA-SR-Memo-1559

North American Aviation, Inc., Downey, Calif.

CORE TANK GALLING TESTS. Ernest Phillips. Jan. 17, 1956. 11p. \$3.30(ph), \$2.40(mf) OTS.

Eleven core tank galling tests were made to determine if galling might take place between the core tank and the slider plate or outer plate. Six tests were made with unlubricated specimens and five tests were made with lubricated specimens. In all but two cases of the eleven tests, moderate to extensive galling took place. In general, lubrication reduces the extent of surface damage and reduces the static and sliding coefficients of friction between mating surfaces of core tank and outer tank specimens. (auth)

10031 NAA-SR-Memo-1565

North American Aviation, Inc., Downey, Calif.

SUMMARY REPORT "PROJECT FREEZE SEAL."

Roman Cygan. Jan. 25, 1956. 19p. \$3.30(ph), \$2.40(mf) OTS.

Five freeze seal designs for the main SRE pumps were built and tested. The design of the seals is presented along with the results of the testing. (W.L.H.)

10032 NAA-SR-Memo-1752

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

THE PHYSICS OF REFRACTORY MATERIALS: I. TRANSITION METALS. John E. Hove. Oct. 12, 1956. 23p. \$4.80(ph), \$2.70(mf) OTS.

The basic question of why some materials melt at lower temperatures than others is considered in relation to the high-melting transition metals. In addition, a brief review of current theories concerning melting and liquids is given. The discussion includes background information on the transition metals as well as a consideration of cohesive energy, the heats of fusion, and other properties of these groups. (J.R.D.)

10033 NASA-M-3-9-59E

National Aeronautics and Space Administration. Lewis Research Center, Cleveland.

TENSILE PROPERTIES OF MOLYBDENUM AND TUNGSTEN FROM 2500° TO 3700°F. Robert W. Hall and Paul F. Sikora. Feb. 1959. 30p.

Specimens of wrought sintered tungsten, arc-cast unalloyed molybdenum, and a molybdenum alloy containing 0.5% titanium were fabricated from 1/2-inch-diameter rolled or swaged bars. Tensile test equipment described herein was used to evaluate the specimens both in the as-received condition and after a 30-minute recrystallization anneal at 3800°F. Two as-received tests were also made on an experimental molybdenum alloy containing 0.46% titanium and 0.07% zirconium. Results show that tungsten was considerably stronger than the molybdenum specimens over the temperature range specified. Differences in the fracture ductility were also observed. (auth)

10034 NASA-M-3-10-59E

National Aeronautics and Space Administration. Lewis Research Center, Cleveland.

OPTIMIZATION OF PARAMETRIC CONSTANTS FOR CREEP-RUPTURE DATA BY MEANS OF LEAST SQUARES. S. S. Manson and A. Mendelson. Mar. 1959. 34p.

An objective method utilizing least squares is presented for the determination of the optimum parametric constants for stress-rupture data. The method is applied to both constant-stress and isothermal data for the Larson-Miller, Manson-Haferd, and Dorn parameters. Several examples are treated in detail. (auth)

10035 NASA-M-4-9-59W

National Bureau of Standards, Washington, D. C.

SPECTRAL EMITTANCE OF UNCOATED AND CERAMIC-COATED INCONEL AND TYPE 321 STAINLESS STEEL. Joseph C. Richmond and James E. Stewart. Apr. 1959. 31p.

The normal spectral emittance of Inconel and type 321 steel with different surface treatments was measured at temperatures of 900, 1,200, 1,500, and 1,800°F over a wavelength range of 1.5 to 15 microns. The measurements involved comparison of the radiant energy emitted by the heated specimen with that emitted by a comparison standard at the same temperature. Surface treatments included electropolishing, sand-

blasting, electropolishing followed by oxidation, sand-blasting followed by oxidation, application of NBS coating A-418, and application of NBS ceramic coating N-143. (auth)

10036 NBL-152

New Brunswick Lab., AEC, N. J.

THE RATING OF THE QUALITY OF URANIUM METALS BY MICROSCOPIC STRINGER COUNTS. S. J. Broderick and A. J. Busch. Feb. 1959. 25p. \$0.75 (OTS).

A method was devised for the rating of the quality of production-grade uranium metal by microscopic stringer counting. The basis of the method is to count the total length of stringers in a polished sample at 100 magnification with the aid of a one-half inch square ruled grid screen. Simplification of the method allows the substitution of standard rating charts for comparison with the sample under observation. The rating method as applied to 40 disk samples from two months production of uranium metal was able to distinguish a difference in the quality of metal as produced by two manufacturers. (auth)

10037 NGTE-M-315

Gt. Brit. National Gas Turbine Establishment,

Farnborough, Hants, England.

THE RELATION OF STRENGTH TO THE THERMAL SHOCK FAILURE OF BRITTLE MATERIALS. M. G. Royston. June 1958. 24p.

It is possible to explain quantitatively the variation of strength of brittle materials with size and mode of stressing. By an extension of Weibull's theory a relation between bend strength and thermal fracture stress can be developed which permits the design of bend strength specimens that fail under conditions analogous to those of thermal shock. (auth)

10038 NMI-1211

Nuclear Metals, Inc., Concord, Mass.

QUARTERLY PROGRESS REPORT TO THE AEC RESEARCH DIVISION FOR THE PERIOD OCTOBER 1, 1958 THROUGH DECEMBER 31, 1958. S. H. Gelles, E. J. Rapperport, and C. S. Hartley. Feb. 12, 1959. 25p. Contract AT(30-1)-1565. \$4.80(ph), \$2.70(mf) OTS.

Be-Fe samples were microradiographed in tests of a method aimed at detection of impurity networks. It was concluded that the present equipment is limited to coarse-grained, high-atomic-number impurities, and that construction of equipment for low-atomic-number impurities is beyond the program scope. A jig for stressing small samples in tension, compression, and bending while observing three surfaces was constructed. A new slip plane (1101) was found in bending at room temperature. An etch pitting for Be was developed, and Be resistivity measurements as a function of temperature were made. In examining the deformation modes of Zr, it was found that twinning was much more in evidence than slip and that the shear stress is about 0.02 kg/mm² at 1075°K. Zr-O systems annealed for 4 months at 800°C absorbed all of the added oxygen. Work on Mg₃Cd twinning was continued; an attempt to substitute Ni₃Sn thus eliminating oxidation problems found in Mg₃Cd was unsuccessful. In a sample of Mg₃Cd prepared in an Ar atmosphere, only moderate twinning was observed. Theories are offered for the limited twinning observed. (For preceding period see NMI-1209.) (J.R.D.)

10039 NMI-1212

Nuclear Metals, Inc., Concord, Mass.

THIRD-DIMENSIONAL DUCTILITY AND CRACK PROPAGATION IN BERYLLIUM SHEET. F. M. Yans. Mar. 18, 1959. 36p. Contract AT(30-1)-1565. \$6.30 (ph), \$3.00 (ph) OTS.

Uniaxial tensile elongations of approximately 20 to 30% were previously achieved in Be sheet fabricated by extrusion and transverse rolling. A new fabrication process was developed whereby the material derived has a good measure of third dimensional ductility, yet allows uniaxial tensile elongations of 15 to 20%; moreover, this material fractures in a completely isotropic fashion, eliminating crack propagation to a very significant degree. This new sheet is made by a process called upsetting, that is, by applying purely compressive forces along the longitudinal axis of a cylindrical Be billet consisting of cold-compacted Be powder inside a steel can. The texture resulting from this operation is the key to the advantageous change in mechanical properties. In respect to the plane of the sheet, the (0001) planes are oriented mainly parallel and the (1120) planes transverse, but random with respect to any direction within the plane. The third dimensional ductility of sheet prepared in three different ways, upset, extruded and transverse-rolled, and hot-pressed, was investigated by performing bend tests on specimens with varying width-to-thickness ratios. In each case, the upset sheet exhibited better third dimensional ductility and strengths under complex stress. The fabrication was performed at 1850°F. 125 sheets were made by this technique with a 97% yield. (auth)

10040 NP-7314

Office of Ordnance Research, Durham, N. C.

CONFERENCE ON BASIC RESEARCH IN METALLURGY AT DUKE UNIVERSITY, DURHAM, NORTH CAROLINA, MARCH 20, 1958. 123p.

A conference in connection with U. S. Army Ordnance research was conducted. No formal papers were presented; however, the proceedings were tape recorded and transcribed. The conference proceedings were grouped under research accomplishments and research in progress. In addition, a list of the titles and scopes of other OOR projects which were not discussed at the conference are included. Discussions were presented at the conference on intermediate phases in alloys composed of the first, second, and third long period transition elements, solid solution strengthening of Mg crystals, lattice imperfections in Mg metal, the structure of sintered carbides, and internal friction in BCC centered alloys. In addition, modes of metal solidification and recrystallization were discussed, as well as the mechanical properties of pure tungsten. (J.R.D.)

10041 NP-7321

Georgia Inst. of Tech., Atlanta. Engineering

Experiment Station.

INVESTIGATION OF HIGH TEMPERATURE RESISTANT MATERIALS. Quarterly Report No. 13 [for] November 1, 1958 to January 31, 1959. C. R. Mason, J. D. Walton, M. D. Bowen, and W. T. Teague. 42p. Project No. A-212. Contract NOrd-15701.

The exhaust gas conditions of the oxyhydrogen rocket motor permit a severe test on an exposed sample in the gas stream. The theoretical velocity in the exit plane is 7900 ft/sec, with a theoretical temperature of 3200°R. These conditions enable stagnation temperatures in ex-

cess of 5500°R to be produced. The calculated heat transfer rate in the stagnation area of a spherical-shaped body in the exhaust gas of the oxyhydrogen rocket motor is 1818 Btu/sec-ft² maintaining a surface temperature of 2000°F. For a body with a radius of 1/2 inch, the heat transfer is 19.8 Btu/sec. This indicates that an internal cooling system would be feasible. A device was designed for ejecting coolant on the stagnation area of a small axially symmetric blunt body and initial tests were begun with fused silica samples. Pigment grade titania powder was prepared for flame spraying by sintering in air at 2000°F for 2.5 hours. This powder produced rather soft, gray coatings. These coatings had excellent impact resistance when the thickness was less than 2.5 mils, the particle size of the sprayed powder between 270 and 325 mesh, and the substrate temperature held below 150°C during spraying. These oxygen-deficient coatings turned back to the original white color of the powder when they were heated to a red heat with an oxygen-rich flame. The reheated coatings were much harder but flaked off on cooling unless the thickness was greater than 20 mils. The 20-mil coatings had poor impact resistance. A base coat of aluminum increased the impact resistance of these reheated coatings significantly. Coatings having a base coat of aluminum 5.5 mils thick and an outer coat of titania 4.0 mils thick remained intact after one thermal cycle to 1500°F in air. An attempt to control the extreme reactions of the beryllium-tungsten trioxide (Be-WO₃) and the beryllium-nickel monoxide (Be-NiO) thermite reactions was made. Beryllia was used as the throttling material. Thermetts composed of approximately 50% beryllium-nickel monoxide thermite and 50% beryllia look promising for further investigation. Studies were continued with the beryllium-chromic oxide thermite for possible use in forming thermet compacts. Powdered chromium was added in varying percentages as the throttling material. Thermet compacts of 40% thermite and 60% chromium when ignited in air or argon produced test specimens with no distortion, no apparent oxidation of chromium, and low porosity. (For preceding period see NP-7117.) (auth)

10042 NP-7362

Alloy Research Corp., Watertown, Mass.
RESEARCH ON THE PROBLEMS OF DUCTILITY IN BERYLLIUM. Progress Report No. 5. Malcolm Basche. Jan. 31, 1959. 7p. Contract AF33(616)-5300.

The production of high-purity Zr was further investigated. The majority of effort was concentrated on an ultra high vacuum system and a halide reduction process for Be. A liner for the reduction tube was made of Mo. A literature search indicated that Mo and Zr do not diffuse. Several zone-refining attempts were made in a moderate vacuum induction apparatus, and enough information was gained to conclude that this method is not practical. The ultra vacuum system chamber was leak tested and found to be tight. The electron gun was completed and was ready for testing. (J.R.D.)

10043 NP-7363

Brush Beryllium Co., Cleveland.
DEVELOPMENT OF WROUGHT BERYLLIUM ALLOYS OF IMPROVED PROPERTIES. Progress Report No. 5 [for] October 1, 1958 to December 31, 1958. J. G. Klein, L. M. Perelman, and W. W. Beaver. Dec. 31, 1958. 27p. Project No. 7(8-7351). USAF Delivery Order 33(616)-57-19.

Beryllium-rich alloys of tin, nickel, zinc, copper,

cadmium, and silver, as well as metal of higher than normal BeO content, were wrought to sheet and rod. Mechanical and physical properties are reported. (auth)

10044 ORNL-2602

Oak Ridge National Lab., Tenn.
DEVELOPMENT OF SILICON-MODIFIED 48 Wt. % U-AL ALLOYS FOR ALUMINUM PLATE-TYPE FUEL ELEMENTS. W. C. Thurber and R. J. Beaver. Mar. 23, 1959. 53p. Contract W-7405-eng-26. \$1.50(OTS).

The casting procedures, mechanical working characteristics, composite fuel plate fabrication, and fuel element assembly methods for a nominal 48 wt. % U-3 wt. % Si-Al alloy are examined. It was found that localized clad thinning, resulting from "dogboning" of the fuel alloy, is essentially eliminated in composite plates when this alloy is used in combination with 5154 Al frames and 1100 Al covers. However, fuel component dimensions are difficult to maintain within commonly accepted tolerances in the brazing process because of the marked differences in the thermal expansion of the fuel alloy and the containment materials. The mechanical properties, irradiation studies, corrosion testing, pneumatic pressure testing, and chemical reprocessing of the Si-modified alloy are also discussed. (auth)

10045 ORNL-2650

Oak Ridge National Lab., Tenn.
THE IMMERSED ULTRASONIC INSPECTION OF METAL PLATE. R. W. McClung. Apr. 6, 1959. 22p. Contract W-7405-eng-26. \$4.80(ph), \$2.70(mf) OTS.

Since metals are being subjected to increasingly more severe service requirements, it is necessary that inspection techniques be developed which will guarantee the integrity of the metals. This paper describes work accomplished in the development of techniques for the ultrasonic inspection of metal plate in thicknesses down to 1/4 in. The method of immersed ultrasonic inspection is briefly discussed. As the mechanical and electronic equipment is described, it is shown that automation could be accomplished easily. The technique is described and many sources of difficulty and their obviations are cited. The specifications and reference standards which were developed for defect evaluation are discussed and typical defects are illustrated. (auth)

10046 RDB(C)/TN-67

Gt. Brit. Culcheth Labs., Culcheth, Lancs, England.
CREEP OF METALS FOR FAST REACTOR FUEL ELEMENT TUBES. A Review of Progress to March 5, 1954. A. Cowan. Apr. 30, 1954. 14p.

Creep tests on commercially pure Ni, Ta, Mo, and Ti were carried out at 600°C. The greatest creep strength was given by the Mo, but the material tested was brittle and subject to cracking on machining. Ni and Ta have appreciable creep strengths, the former undergoing 0.4% creep strain after 11,000 hours under a stress of 2 tons/in.² at 600°C. Comparative tests to determine the effect of NaK show no variation in creep strength, but the validity of these tests is questionable due to vaporization of the liquid metal. (auth)

10047 RDB(C)/TN-93

Gt. Brit. Culcheth Labs., Culcheth, Lancs, England.
THE CORROSION OF WELD STRIKE DEPOSITS UNDER CONDITIONS SIMULATING THOSE IN THE EFFLUENT TANKS AT WINDSCALE. T. E. Evans and H. N. Jones. Aug. 17, 1954. 17p.

An investigation was carried out to assess whether, under the conditions prevailing in the highly active efflu-

ent plant at Windscale, there is any possibility of the propagation of cracks known to be present in weld deposits made by striking the arc on areas of plate adjacent to constructional welds prior to welding. Corrosion tests on a large number of strike deposits made in this manner indicated that, in a solution which simulated as closely as possible the final composition of the effluent liquor, the existing cracks did not propagate and that no new cracks were opened up. Under more rigorous conditions it was further shown that the strike deposits were anodic to the parent metal and eventually dissolved completely to leave a shallow crater in the plate. (auth)

10048 RDB(C)/TN-104

United Kingdom Atomic Energy Authority. Industrial Group. Culcheth Labs., Culcheth, Lancs, England. THE ARC MELTING OF REFRACTORY METALS. A Review of Progress from May 15, 1954 to October 11, 1954. H. N. Jones. Dec. 20, 1954. 19p.

The construction of an arc melting furnace for 2 in. diameter ingots was completed, and operational trials were started. A new furnace for small-scale experiments is being manufactured, and its features are described. Experiments with the Mark II furnace showed the importance of proper outgassing, and a suitable technique was evolved. Attempts to obtain a stable arc in vacuo were abandoned, and heating by electron bombardment is being investigated. (auth)

10049 RDB(R)/TN-51

United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England. CIRCULATING LOOPS FOR HIGH TEMPERATURE DYNAMIC CORROSION STUDIES IN WATER. E. Catling. June 3, 1955. 13p. (LEO-RDC/P-34).

A description of test rigs being constructed for the study of the corrosion of metals in water at high temperatures is given. A suggested schedule of operations to be followed in carrying out the basic procedure of charging, heating, and cooling the rig is included, and a summary of physical information relating to the construction as a whole and the component vessels is given. (auth)

10050 RISLEY-5006/74

Gt. Brit. Div. of Atomic Energy (Production), Risley, Lancs, England.

STAINLESS STEEL FABRICATION AT WINDSCALE WORKS. E. H. Wills. Aug. 25, 1953. 39p.

This report is a record of the practical methods employed by the Engineering Department and Contractors at Windscale Works for the fabrication, welding, installation, and inspection of stainless steel vessels and pipework required for the Separation Group. Emphasis was placed on the actual methods employed by the craftsmen and inspectors in order that the completed plant would conform to specifications which are included. (auth)

10051 WADC-TR-58-409

Chase Brass and Copper Co., Inc., Waterbury, Conn. HEAT TREATMENT RESPONSE, MECHANICAL PROPERTIES AND STABILITY OF TITANIUM SHEET ALLOYS. Period Covered: May 1956 to August 1958. Eugene Delgrosso, Peter Kuzmenko, Allan Springmeyer, Brian Weldon, A. Richard Zello, and James Chafey. Oct. 14, 1958. 116p. Project title: METALLIC MATERIALS. Task title: TITANIUM METAL AND ALLOYS. Contract AF33(616)-3585. (AD-207791).

The effect of various heat treatments on the mechanical

properties of two titanium alloys was determined. The two types of heat treatments utilized were: (1) solution treatment and water quench, (2) solution treatment, water quench, and age. The alloys, Ti-4Al-3Mo-1V and Ti-15V-2.5Al, were investigated in the form of approximately 0.040" sheet. Three interstitial content levels of each alloy were investigated. Beta transus temperatures were determined for the alloys. Room temperature mechanical properties were evaluated for the solution treated and aged conditions of the alloys for both standard and notched tensile configurations. Elevated temperature tensile properties were determined. The effect of deformation, via two degrees of rolling or stretching, on aging characteristics was ascertained. Three hundred hour creep tests were conducted at 600 and 800°F. Creep embrittlement was evaluated. A microstructural examination was conducted. Also, the alloy Ti-4Al-1Pb-1Sn-1V-1Zr was prepared in sheet form, and some of its mechanical properties were evaluated. (auth)

10052 WADC-TR-58-438

Battelle Memorial Inst., Columbus, Ohio.

AN INVESTIGATION OF THE EFFECTS OF IMPURITIES AND METALLURGICAL VARIABLES ON THE NOTCH SENSITIVITY OF TITANIUM ALLOYS. Period Covered: March 1, 1957 to February 28, 1958.

Frank C. Holden, Richard W. Douglass, Horace R. Ogden, and Robert L. Jaffee. Mar. 31, 1958. 86p.

Project title: METALLIC MATERIALS. Task title: TITANIUM METALS AND ALLOYS. Contract AF33(616)-5007. (AD-207078).

The notch tensile properties of three commercial titanium-base alloys, A110AT (Ti-5.0Al-2.5Sn), Ti-6Al-4V, and Ti-140A (Ti-2Fe-2Cr-2Mo), were investigated at six interstitial levels, four microstructural conditions, and over a range of temperatures from -196 to 200°C. Notch sensitivity generally was increased by increased interstitial content, low temperature, and acicular-type microstructures. In addition, sensitivity to slow-strain hydrogen embrittlement was observed in the temperature range near 0°C at hydrogen levels well below specification limits. (auth)

10053 WADC-TR-58-452

New York. State Univ. Coll. of Ceramics, Alfred. METAL FIBER REINFORCED CERAMICS. Period covered: July 1, 1957 to June 30, 1958. R. S. Truesdale, J. J. Swica, and J. R. Tinklepaugh. Sept. 24, 1958. 44p. Project title: CERAMIC AND CERMET MATERIALS. Task title: CERAMIC AND CERMET MATERIALS DEVELOPMENT. Contract AF33(616)-5298. (AD-207079).

Techniques were developed for the sintering and hot pressing of alumina and alumina containing 5 wt. %, 10 wt. %, and 20 wt. % molybdenum fibers. The physical and mechanical properties of alumina containing these percentages of 1/4 in. long by 0.002 in. diam. fibers were determined and compared to those of the alumina. The alumina was superior in strength and impact resistance, but there was some indication that the aluminas containing 10 and 20 wt. % additions of fiber were superior in thermal shock resistance. All alumina samples containing 10 and 20% additions developed microcracks while only some 5% samples developed these cracks. (auth)

10054 WADC-TR-58-467

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

BRAZING TITANIUM SANDWICH CONSTRUCTION.

Period covered: July 1, 1957 to July 30, 1958. John F. Rudy, Robert M. Necheles, and Harry Schwartzbart. July 15, 1958. 97p. Project title: METALLIC MATERIALS. Task title: WELDING BRAZING AND SOLDERING OF METAL. Contract AF33(616)-5357. (AD-207904).

The purpose of this project was to study the feasibility of fabricating titanium alloy face sheet honeycomb sandwiches by brazing techniques. The program was conveniently divided into several phases: selection of face sheet alloy and brazing alloys, fabrication of sandwiches by various experimental methods, and mechanical evaluation of the resulting panels. The emphasis was placed on the second phase, fabrication processes. The survey of possible face sheet alloys is discussed in some detail. The result of this survey was the decision to incorporate Mallory-Sharon's MST 16V-2 $\frac{1}{2}$ Al for the alloy for primary consideration as the face sheet in the brazing process experimentation. In addition to the above alloy, Republic Steel's RS 140 (5Al-2 $\frac{3}{4}$ Cr-1 $\frac{1}{4}$ Fe) was chosen as an alternative alloy for brazing above the beta transus (-1440°F) of the MST alloy. In making these selections consideration was given to producibility in thin-rolled sections, mechanical properties at room and elevated temperatures, and, possibly most important, the compatibility of the heat treatment cycle with the envisioned practical brazing cycle. An evaluation of 17 brazing alloys as regards wettability, mechanical strength, oxidation resistance, and corrosion resistance resulted in the recommendation of Ag-28Cu-0.2Li and Ag-0.25Mg-0.2Ni-1Li as the best alloys for brazing titanium-cored panels at a brazing temperature of 1500°F . Ag-28Cu-0.2Li was the stronger of the two. These two alloys plus Ag-7Cu-0.2Li and Ag-30Cu-10Sn were found to be satisfactory for brazing stainless steel cored panel at 1600°F . Of these four alloys, Ag-28Cu-0.2Li and Ag-7Cu-0.2Li gave the strongest joints. The process development phase centered around the development of a quartz lamp radiant heat brazement process. The details of the process, as used, and a discussion of suggested modifications and improvements for application of the same principles to large-production panel fabrication, are presented. Although the process development experiments were conducted with titanium alloy face sheet materials, the results are applicable to sandwich panel production in general. The primary advantages of quartz lamp radiant heat over presently used furnace retort techniques have to do with inherent rapid heating and cooling rates, good temperature uniformity and brazing time control, and general cleanliness of the heat source for atmosphere purity purposes. (auth)

10055 WADC-TR-58-481

Wright Air Development Center. Materials Lab.,

Wright-Patterson AFB, Ohio

A NEW LOOK AT THE HYDROGEN EMBRITTLEMENT OF CADMIUM COATED HIGH STRENGTH STEELS.

[Period covered]: January 1956 to May 1958.

Norman M. Geyer, G. William Lawless, and Bennie Cohen. Nov. 14, 1958. 61p. Project title: FINISHES AND MATERIALS PRESERVATION. Task title: ELECTRODEPOSITION AND ELECTROCHEMICAL TREATMENTS. (AD-206386).

A reliable and sensitive test procedure for ascertaining detrimental hydrogen embrittlement as a result of cadmium plating was established. The test consists of

a sustained loaded notched tensile specimen, loaded at 75% of the ultimate notched tensile strength for a minimum of 200 hours. Detrimental hydrogen embrittlement is shown to be dependent upon the steel alloy, the current efficiency of the cadmium plating bath, and the physical structure of cadmium coating obtained. Current efficiency-current density curves were obtained for the conventional cadmium cyanide bath, the high efficiency cadmium cyanide bath, the cadmium sulfamate bath, and the cadmium fluoroborate bath. Cadmium electroplating processes for coating high-strength steel, 280,000 psi UTS, without detrimental hydrogen embrittlement are given. Vacuum cadmium metallized coatings are also shown to be non-embrittling to high-strength steels. (auth)

10056 WADC-TR-58-546

General Electric Co. Thomson Lab., Lynn, Mass.

EVALUATION OF ALLOYS FOR HIGH TEMPERATURE GEAR APPLICATIONS.

Period covered: June 1, 1957 to August 31, 1958. E. G. Jackson, C. F. Muench, E. H. Rowe, and E. H. Scott. Oct. 30, 1958. 85p. Project title: METALLIC MATERIALS. Task title: HIGH TEMPERATURE ALLOYS. Contract AF33(616)-5266. (AD-206666).

The selection of materials for use in high mach number aircraft gears requires consideration of high-temperature physical, mechanical, and chemical properties and of rubbing compatibility. This program was designed to obtain bench test data on ten different materials for application as gears at operating temperatures to 700°F . Oils representing two important classes, silicone and mineral, were chosen for scoring tests. High temperature data were obtained on hardness, dimensional stability, tensile, impact and tooth fatigue strengths, corrosion and oxidation, and on surface scoring resistance. The most fatigue resistant material was Modified M50, Carburized, while Matrix M2 was the best of the through-hardened steels. In score resistance, the best material depended on the oil; L.P.D. (Vacuum), Nitrided was the best with silicone, but M1 rose from second place with silicone to first with mineral oil. Choice of material for any application must depend on whether tooth breakage or scoring is the limiting factor, however, the L.P.D. (Vacuum) Nitrided is the best compromise since it ranked high in all tests. (auth)

10057 WAPD-PWR-PMM-1806

Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh.

DEVELOPMENT OF BORON-BEARING MATERIALS FOR PRESSURIZED WATER REACTOR (PWR) CONTROL RODS.

E. F. Losco and H. J. Snyder. Jan. 1958. 60p. \$9.30(ph), \$3.60(mf) OTS.

Boron-bearing materials were investigated for possible application as low-cost, high-performance PWR control rods. Two types of materials were considered. These included (1) stainless steel-enriched boron powder dispersion inserts contained in compartmented stainless steel structural alloys and (2) copper-natural boron carbide powder dispersions clad by roll-bonding to stainless steel. Both types of materials presented several serious manufacturing problems the solutions to which would result in little or no cost or performance advantage over the reference hafnium control rods. These findings, coupled with the very promising results obtained on silver-indium-cadmium alloys prompted continued development effort on the latter alloys at the

expense of the boron-bearing materials. This report presents complete data and discussion of results obtained on the boron-bearing materials investigated.

(auth)

10058 WAPD-TM-171

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. HYDROGEN REDISTRIBUTION IN ZIRCALOY-2 UNDER THERMAL AND MECHANICAL STRESS GRADIENTS. J. M. Markowitz. Jan. 1959. 20p. Contract AT-11-1-GEN-14. \$0.75(OTS).

Past and current work on the study of the movement of dissolved hydrogen in Zircaloy-2 under the influence of thermal and mechanical stress and two-phase activity gradients is reviewed, and the findings are discussed. A program of future work is presented. (auth)

10059 WAPD-ZH-14

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. ZIRCONIUM HIGHLIGHTS. Jan. 1959. 25p. Contract AT-11-1-GEN-14. \$4.80(ph), \$2.70(mf) OTS.

Some aspects of zirconium metallurgical developments are presented. Included is a proposal to initiate a program of irradiation of Zircaloy-2 aimed at producing results which can be used to predict behavior of this alloy in reactor cores. In addition, results of a preliminary test which show several of the characteristics of a strain aging material in Zircaloy-2 are presented. Also, the effect of tungsten contamination on corrosion of Zircaloy-2 was examined. Conclusions are given and graphs are presented. Other information is presented concerning an attempt to improve ductility and corrosion resistance of beta-treated Zircaloy-2 and an evaluation of large Zircaloy-2 ingots. (J.R.D.)

10060 AEC-tr-3576

ON THE CONSTITUTION DIAGRAM OF THE SYSTEM COPPER-SILVER-INDIUM. II. EQUILIBRIUM COURSE UP TO INDIUM CONTENTS OF 30%. (Über den Aufbau des Systems Kupfer-Silber-Indium. II. Gleichgewichtsverlauf bis zu Indiumgehalten von 30%.) Erich Gebhardt and Manfred Dreher. Translated for Oak Ridge National Lab. from *Z. Metallk.* 43, 357-62 (1952). 32p. (Includes original, 13p.). \$6.30(ph), \$3.00(mf) JCL or LC.

The partial range adjoining the copper-silver side was investigated up to indium contents of 35%. Results reported are based on extensive thermal, microscopic, and x-ray investigations as well as on measurements of the electric conductivity. Temperature-concentration diagrams with correspondingly uniform indium contents of 10, 20, 25, and 30% as well as three isothermal sections at 550, 500, and 450°C were formulated. A good picture of the shape of the constitution regions in relation to temperature and concentration can be imparted. A total of six quaternary phase transformations whose temperatures were found to be 600, 575, 560, 490, 485, and 475°C were determined in the partial range under investigation. The equations for the individual transformations are given. (auth)

10061 AEC-tr-3597

ON SLIP SHRINKAGE IN METAL-METAL OXIDE MIXTURES AND IN BORON CARBIDE. W. Dawidl. Translated for Los Alamos Scientific Lab. from *Z. Metallk.* 43, 138-42(1952). 7p. \$1.80(ph), \$1.80(mf) JCL or LC.

The phenomenon of increasing mechanical adherence occurring with increasing temperature during the heating of crushed aggregates or compacted powders to temperatures below that of complete fusion is consid-

ered. It is shown that in addition to grain formation or deformation, the shrinkage which takes place along with the adherence increase is due to slip shrinkage caused by increased mobility of atoms in the grain surface. The loosened surface layers which cause slip shrinkage may be compared with the intermediate layers which form at grain boundaries during solidification of molten metals. It is also shown that the intermediate layers which form in such hard materials as the IV, V, and VI group metal carbides inhibit grain growth in these materials. (J.R.D.)

10062 AERE-Trans-11/3/5/1169

DETERMINATION OF DIFFUSION PARAMETERS FOR IRON AND CHROMIUM IN CERTAIN ALLOYS. L. I. Ivanov and N. P. Ivanchev. Translated by J. Adam (U.K.A.E.A., Atomic Energy Research Establishment) from *Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk*, No. 8, 15-18(1958). 6p. (Figures omitted). \$1.80(ph), \$1.80(mf) JCL or LC.

Diffusion parameters for iron and chromium were determined on a series of alloys in the alpha region at temperatures above the α phase. Cr^{51} and Fe^{59} were deposited on sample faces by evaporation from tungsten. Diffusion annealing was performed, and layers were subsequently removed from the samples for counting. The diffusion coefficients are listed as well as activation energy. Formulas for expressing the temperature dependence of diffusion are also presented. (J.R.D.)

10063 CEA-tr-A-507

ETUDES MICRO-RADIOGRAPHIQUES DU PHÉNOMÈNE DE LAMINAGE. (Microradiographic Studies of the Lamination Phenomenon.) F. Erdmann-Jesnitzner and F. Günther. Translated into French from *Z. Metallk.* 49, 9-16(1958). 31p.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 7286.

10064 NP-tr-225

THE USE OF RADIOACTIVE ISOTOPES IN METALLURGY. (Primeneniye Radioaktivnykh Izotopov v Metallurgii.) I. S. Kulikov and I. A. Popov—N. V. Agreyev and V. F. Smirnov, eds. Translation of a publication from State Scientific and Technical Publishing House for Literature on Ferrous and Nonferrous Metallurgy, Moscow, 1956. 330p.

The principals of radioactivity are reviewed, and radioactive isotope applications in the metallurgy of iron and steel are considered. Reference material for calculations related to radioactive measurements are included in the appendix. The book is intended for use as a metallurgical reference useful to those using radioactive isotopes in investigations, and to higher metallurgical schools. 132 references. (J.R.D.)

10065

UNIT CELL AND THERMAL EXPANSION OF β -PLUTONIUM METAL. W. H. Zachariasen (Univ. of Chicago) and F. H. Ellinger (Los Alamos Scientific Lab., N. Mex.). *Acta Cryst.* 12, 175-6(1959) Mar.

β -Pu is monoclinic body-centered with 34 atoms per unit cell. At 190°C $a = 9.284$, $b = 10.463$, $c = 7.859$ Å, $\beta = 92.13^\circ$ and the density is 17.70 g cm^{-3} . Preliminary values are reported for the thermal expansion coefficients. (auth)

10066

FABRICATING THE FUEL ELEMENTS. *Atomic World* 10, 101-2(1959) Mar.

The casting, machining, heat treating, and canning of

U fuel elements at the Springfields factory are described. (T.R.H.)

10067

METALLOGRAPHIC INVESTIGATION OF WELD JOINTS IN ZIRCONIUM. S. M. Gurevich and V. F. Grablin. *Avtomat. svarka* No. 9, 33-6(1958). [In Russian]

As existing methods of polishing weld joints in zirconium do not comply with requirements, the Institute of Electric Welding developed a new method of preparing microsections of zirconium weld joints by machining, combined with subsequent electrolytic polishing. The new method produces smooth surfaces and a clear picture of the structure for investigations on optical and electronic microscopes. (TCO)

10068

MANUFACTURE AND APPLICATIONS OF COBALT-BASE ALLOY. P. van Bleyenbergh. *Cobalt* No. 2, 3-10(1959) Mar.

A Co-Cr-Fe alloy, containing 50% cobalt and 50% ferro-chromium, has recently been developed by the Jadotville foundry. Easy to cast and calling for no heat-treatment, it has already found numerous applications in U.M.H.K. African plants, for parts requiring high mechanical strength either at elevated temperature or in corrosive media. The wrought alloy derived from the above will carry even higher loads under the same conditions. The alloy has definitely attractive possibilities, as has been exemplified by the numerous cases of successful application in U.M.H.K. plants. Therefore, it should rapidly occupy a relatively important position in certain appropriate fields which will expand as new grades are developed. (auth)

10069

"SECONDARY" RECRYSTALLIZATION AND "TERTIARY" RECRYSTALLIZATION OF SOFT IRON COLD WORKED BY ROLLING AND ANNEALED UNDER HYDROGEN. Pierre Coulomb and Paul Lacombe. *Compt. rend.* 248, 964-6(1959) Feb. 16. [In French]

Soft iron rolled and annealed under hydrogen presents a "secondary" texture marked by the absence of (100) crystals parallel to the plane of the sheet. This texture formed of (110), (111), and (112) grains is, in general, replaced by a "tertiary" texture with large (110) [001] grains. (tr-auth)

10070

SOLUBILITY OF HYDROGEN IN STAINLESS STEEL. René Blanchard. *Compt. rend.* 248, 966-8(1959) Feb. 16. [In French]

The solubility of hydrogen in 18-8 stainless at 700 to 1000°C varies from 5.3 to 7.25 cm³/100 g. The addition elements (Mo and Nb) cause a small decrease of the solubility. (tr-auth)

10071

THE POLYGONIZATION OF ALUMINUM OF DIFFERENT PURITIES. Jean Montuelle. *Compt. rend.* 248, 1174-7(1959) Feb. 23. [In French]

A micrographic study was made of the polygonization of aluminum of different purities under various conditions. The diversity of forms, orientations, and dimensions of the substructures of polygonization caused by different deformation and annealing conditions is shown. (J.S.R.)

10072

THE CORROSION OF ZIRCONIUM IN HYDROCHLORIC ACID AT ATMOSPHERIC PRESSURE. W. E. Kuhn (The

Carborundum Co., Niagara Falls, N. Y.). *Corrosion* 15, 103t-12t(1959) Mar.

Short-term (144 hour) corrosion tests of zirconium subjected to differing surface treatments prior to immersion in aqueous hydrochloric acid solutions suggested that factors involved in film formation play a dominant role in the corrosion behavior of zirconium. Long duration tests (2000 hours) revealed two general types of protective films: one, a protective primordial zirconium oxide film, and the other, a face-centered cubic zirconium monohydride film. The oxide film is subject to failure by a "breakaway" mechanism involving the formation of an interfacial hydride layer at the oxide-metal interface which eventually causes the protective film to suddenly loosen and flake away. The time for this to occur may vary from less than 144 hours to greater than 2000 hours depending on the integrity of the oxide film. The integrity of the film is in turn dependent on the history of its formation. After "breakaway" the corrosion rate loss in boiling 20 percent hydrochloric acid may range from 3 to a maximum of 4.5 mils per year. Protective hydride films are black, vary widely in the degree of protection they offer, and appear to be highly sensitive to surface preparation. Chemically polished surfaces produce porous hydride films which offer little protection whereas electrolytically polished specimens produce dense films which are very resistant to hydrochloric acid. The various mechanisms of corrosion are described and discussed in the light of the work of other investigators. Photomicrographs of the surface of various characteristic types of film formation are shown and their appearance is explained in terms of the postulated corrosion mechanisms. (auth)

10073

HIGH TEMPERATURE OXIDATION OF CHROMIUM-NICKEL STEELS. D. Caplan and M. Cohen (National Research Council of Canada, Ottawa). *Corrosion* 15, 141t-6t(1959) Mar.

The scaling of austenitic stainless steels Type 302, 309, and 330 has been investigated by weight gain vs. time measurements in air at 1600 to 2000°F and subsequent examination of the scales. As had been found previously with chromium steel, the curves exhibit breaks indicating intermediate periods of rapid oxidation due to disruption of the protective scale layer. Accumulation of silica at the metal/scale interface is found to contribute to this disruption; voids are considered to have the same effect. A distinction is drawn between such breaks and the type which arises from the extraordinary protectiveness of an initial thin oxide film, which is markedly affected by surface preparation and prior treatment. (auth)

10074

CORROSION PROBLEMS ASSOCIATED WITH URANIUM REFINING. F. H. Meyer, Jr., F. J. Podlipiec, and T. R. Kato (National Lead Co. of Ohio, Cincinnati). *Corrosion* 15, 168t-70t(1959) Apr.

A summary is made of some of the special corrosion problems associated with the production of uranium metal from ore concentrates. After a description is given of processing conditions and existing materials of construction, corrosion rates and effects are related to: (a) variable ore composition, (b) alternate materials of construction, (c) variable operating conditions, and (d) maintenance of product purity. Changes made in

the processing system and materials of construction necessitated by the severity of corrosion are discussed. The basic refining process is described and the performance of presently used and alternate materials of construction are compared. (auth)

10075

X-RAY STUDY OF FINE STRUCTURE OF PULVERIZED NICKEL. Adela Kochanovska. *Czechoslov. J. Phys.* **7**, No. 2, 150-61(1957). (Translated from *Referat. Zhur. Khim.* No. 8, 1958, Abstract No. 31496.)

The study of changes in the fine structure of Ni (by the changes of the width, intensity, and position of diffraction rings) during the process of continuous pulverization was carried out. Based on these data, distortions of the I and II classes, which appear at laminar deformation displacements and in the result of the plastic anisotropy, were investigated. The changes discovered in interplanar distances are interpreted as volumetric changes of the crystal lattice.

10076

ON THE INTERACTION OF SPODUMENE AND ALKALINE METAL SULPHATES. V. E. Plyushchev (Lomonosov Moscow Inst. of Fine Chemical Tech.). *Doklady Akad. Nauk S.S.S.R.* **124**, 642-5(1959) Jan. 21. (In Russian)

Preliminary studies β spodumene reactions with K_2SO_4 at 700 to 1100°C with various component ratios showed that at 700°C the formation of Li_2SO_4 begins in the solid phase; above 1100°C the sintering of the mixture particles changes to fusion which slows the transition of lithium into the soluble phase. In β spodumene sintered with K_2SO_4 , sodium (as $NaSO_4$) also transforms into a soluble phase. Experiments confirmed the favorable properties of spodumene as an initial material for high-temperature synthesis. The reaction of thermally enriched spodumenes with 5.44% Li_2O , 3.20% NaO , 28.33% Al_2O_3 , 62.60% SiO_2 , and 0.11% CaO (K_2O not present) with alkali sulfate metals was studied in a wide range of temperatures. The analysis for aluminum and soluble SiO_2 in spodumene sintered with K_2SO_4 , Rb_2SO_4 , and Cs_2SO_4 (but not in Na_2SO_4) showed negative results. A general character was observed in the β spodumene reaction with alkali sulfate metals with melting points above 1000°C, e.g., K_2SO_4 (1069°), Rb_2SO_4 (1074°), and Cs_2SO_4 (1019°). Tabulated data on identification of potassium, rubidium, and cesium aluminosilicates prepared with β spodumenes are included. (R.V.J.)

10077

THE K ABSORPTION EDGE OF IRON IN THE α AND σ PHASES OF THE Fe-Cr SYSTEM. V. A. Kazantsev (Shevchenko Lugansk State Pedagogical Inst.). *Doklady Akad. Nauk S.S.S.R.* **124**, 806-7(1959) Feb. 1. (In Russian)

The nature of the $\alpha \rightarrow \sigma$ phase transitions in binary Fe-Cr was investigated. The K spectra of iron in the α and σ phases were obtained with a strong vacuum spectrograph with a bent crystal. The iron absorption spectra in the α phase were less contrasting than in the σ phase. The graph of iron K-edge absorption in the α and σ phases is plotted. (R.V.J.)

10078

X-RAY STUDY OF TITANIUM OXIDES IN TITANIUM SLAGS. M. S. Model (Baikov Inst. of Metallurgy, Academy of Sciences, U.S.S.R.). *Doklady Akad. Nauk S.S.S.R.* **124**, 887-9(1959) Feb. 1. (In Russian)

X-ray studies were made of the phase constitution of titanium-containing industrial slags or similar synthetic specimens of oxide systems $MgO-TiO_2$, $FeO-TiO_2$, $CaO-TiO_2$, $Al_2O_3-TiO_2$, $MgO-CaO-TiO_2$, $FeO-MgO-Al_2O_3-TiO_2$, $CaO-TiO_2-SiO_2$, and $CaO-TiO_2-SiO_2-Al_2O_3$. The specimens were smelted under reduction conditions and did not possess an equilibrium constitution diagram. Modifications TiO (NaCl-type structure) and Ti_2O_3 ($\alpha = Al_2O_3$ structure) were observed in slag systems smelted in strongly reducing conditions. Under more moderate reduction, Ti_2O_3 appears in two modifications. The type of modification depends strongly on the composition of the system. (R.V.J.)

10079

INVESTIGATION OF THE CAKING KINETICS OF NICKEL, COPPER, AND MOLYBDENUM POWDERS BY DILATOMETRY. R. S. Mints (Baikov Inst. of Metallurgy, Academy of Sciences, U.S.S.R.). *Doklady Akad. Nauk S.S.S.R.* **124**, 1240-2(1959) Feb. 21. (In Russian)

A dilatometric study of sintering processes for nickel, molybdenum, and copper powders showed the feasibility of replacing isothermal sintering by cyclic. Experiments were carried out in a vacuum dilatometer, and the curves of cyclic sintering are plotted. (R.V.J.)

10080

PHASE COMPOSITION OF ALLOYS IN THE COBALT-BORON SYSTEM. P. T. Kolomytsev (Zhukovskii Air Force Engineering Academy). *Doklady Akad. Nauk S.S.S.R.* **124**, 1247-50(1959) Feb. 21. (In Russian)

Phase studies made with 20 prepared specimens containing more than 4% boron disclosed a Co_3B compound whose lattice was isomorphous to the Ni_3B lattice and also verified the x-ray data on CoB . It was also found that in a cobalt-boron system the compounds Co_3B , Co_2B , and CoB have similar microhardness, which is 1145 kg/mm². In the boron enriched η phase the microhardness increases by a factor of 2, up to 2575 kg/mm². (R.V.J.)

10081

NEED LOW-COBALT STAINLESS FOR NUCLEAR APPLICATIONS. W. L. Fleischmann (Knolls Atomic Power Lab., Schenectady, N. Y.) *Iron Age* **183**, No. 7, 106-7(1959) Feb. 12.

Problems resulting from the effects of the cobalt content in stainless steels for reactor applications are discussed. Some suggestions are offered in the selection of materials which will aid in the solution of these problems. Tabulations are given which show the cobalt content in a number of stainless steels and ferroalloys. (J.H.M.)

10082

AM-355: HIGH-STRENGTH STAINLESS, IT LINKS GOOD CORROSION RESISTANCE WITH EASE OF FABRICATION. G. N. Aggen (Allegheny Ludlum Steel Corp., Brackenridge, Penna.). *Iron Age* **183**, No. 14, 74-7(1959) Apr. 2.

The properties, fabrication, and uses of high-strength low-alloy AM-355 stainless steel are discussed. Tensile properties, stress rupture and creep properties, Charpy U-notch impact strength, and corrosion resistance are tabulated. Forging, heat-treating, machining, and welding are discussed. (T.R.H.)

10083

CORROSION BEHAVIOUR OF SOME OF THE NEWER

METALS. N. P. Inglis and J. B. Cotton. Eng. Materials and Design **2**, 78-80(1959) Feb.

The corrosion behavior of tantalum, niobium, titanium, zirconium, and beryllium is discussed. The intrinsic reactivity of the metals is outlined, and a chart is presented in which the comparative resistance to corrosion of the five metals is summarized. Their corrosion behavior is considered with reference to the formation of an oxide or surface film, raising of the potential, and the mechanism of surface passivation. Mention is made of the behavior of titanium under an impressed current, and the future possibilities of the metals are indicated. (auth)

10084

SUB-ZERO TEMPERATURE RESEARCH IMPROVES MATERIALS. Charles L. Schuettler (American Instrument Co., Silver Spring, Md.). Ind. Labs. **10**, 9-14 (1959) Jan.

Data are presented summarizing the conclusions derived from the use of sub-zero temperatures in the fields of research, testing, and industrial processing. Photomicrographic studies of various high-speed steels showed important changes in grain structure from cold treatment. (J.E.D.)

10085

REINFORCED PLASTICS IN HIGH TEMPERATURE APPLICATIONS. Edwin H. Jaffe (Rocketdyne Div., North American Aviation, Inc., Canoga Park, Calif.). Ind. Labs. **10**, No. 3, 67-8, 70-2, 74(1959) Mar.

The applications of reinforced plastics in the field of missiles and rockets are briefly discussed. How the use of reinforced plastic would have solved the problem of Thor vernier rocket flame impingement on the main thrust chamber nozzle is shown. (T.R.H.)

10086

DENSIFICATION DURING SINTERING IN THE PRESENCE OF A LIQUID PHASE. I. THEORY. W. D. Kingery (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys. **30**, 301-6(1959) Mar.

The driving force leading to densification during sintering in the presence of a liquid phase and the material transport phenomena were analyzed, and relationships for the densification rate during the rearrangement process, the solution-precipitation process, and the final coalescence process were determined. These relationships allow an experimental determination of the mechanism of sintering in the presence of a liquid phase on the basis of the time, particle size, and temperature dependence of the densification rate. In addition, they allow direct calculations of densification rates to be made for certain simple systems for which property data are available. (auth)

10087

DENSIFICATION DURING SINTERING IN THE PRESENCE OF A LIQUID PHASE. II. EXPERIMENTAL. W. D. Kingery and M. D. Narasimhan (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys. **30**, 307-10 (1959) Mar.

Experimental measurements of the densification rate and microstructure changes taking place during sintering of the iron-copper system, which is typical of those systems showing spheroidal grain development, indicate that in this system the rate of densification during liquid phase sintering is controlled by diffusion through a liquid film between particles. Dependence of

the sintering rate on time, particle size, and temperature are in agreement with theoretical predictions. A theoretical estimation of the sintering rate is in good agreement with experimental measurements. (auth)

10088

FIELD EMISSION FROM METAL WHISKERS. A. J. Melmed and R. Gomer (Univ. of Chicago). J. Chem. Phys. **30**, 586-7(1959) Feb.

A method is presented for growing metal whiskers of great strength. Field emission patterns of vapor-grown whiskers of Al, Cu, and Fe are presented. (W.L.H.)

10089

LOCAL CELL ACTION DURING THE SCALING OF METALS. II. Christa Ilchner-Gensch (Massachusetts Inst. of Tech., Cambridge). J. Electrochem. Soc. **105**, 635-8(1958) Nov.

If nickel is covered by a borate melt under an oxygen atmosphere, practically no oxidation takes place. If, however, the nickel sample is in electrical contact with an electronic conductor, e.g., a noble metal gauze, which extends up to the melt-oxygen interface, nickel is attacked rapidly by virtue of local cell action. In this case, electron transfer is accomplished by the metal gauze and ions migrate through the borate melt. Electrochemical measurements show that the reaction is controlled mainly by polarization of the cathode where oxygen molecules are reduced to ions. (auth)

10090

THE DIFFUSION OF OXYGEN IN ALPHA AND BETA ZIRCALOY 2 AND ZIRCALOY 3 AT HIGH TEMPERATURES. M. W. Mallett, W. M. Albrecht, and P. R. Wilson (Battelle Memorial Inst., Columbus, Ohio). J. Electrochem. Soc. **106**, 181-4(1959) Mar.

The diffusion rates of oxygen in alpha and beta Zircaloy-2 and Zircaloy-3 were determined in the range 1000 to 1500°C. For alpha Zircaloy-2, the variation of the diffusion coefficient, D , in cm^2/sec , with temperature is given by the equation $D_\alpha = 0.196 \exp (-41,000 \pm 1500/RT)$. For beta Zircaloy-2, $D_\beta = 0.0453 \exp (-28,200 \pm 2400/RT)$. Spot checks of the diffusion of oxygen in alpha and beta Zircaloy-3 to 1100 and 1400°C show that the rates are in close agreement with those for oxygen in Zircaloy-2. The diffusion coefficients for oxygen in beta Zircaloy-2 and Zircaloy-3 are about 10 times greater than those for nitrogen in high-purity beta zirconium. (auth)

10091

DIFFUSION PROCESSES IN BIMETAL STEEL-ALUMINUM DURING HEAT TREATMENTS. A. D. Kuritsyna, F. V. Korolev, and K. N. Korsunskaya (Inst. of Machine Building, Academy of Sciences, USSR). Metalloved. i Termich. Obrabotka Metal. No. 2, 2-7(1959) Feb. (In Russian)

Studies were made of the diffusion process in the steel-aluminum alloy boundary and its dependence on external factors (temperature, soaking time, and composition of the contacting metals). Four stages of diffusion were observed in the temperature interval 510 to 700°C. (R.V.J.)

10092

RADIOGRAPHIC STUDIES OF CARBON DISTRIBUTION IN CHROMIUM-NICKEL STEEL. B. I. Bruk and V. V. Nyrkovskaya. Metalloved. i Termich. Obrabotka Metal. No. 2, 22-8(1959) Feb. (In Russian)

Carbon-14 was used to determine the regularities of carbon distribution in chromium-nickel stainless

steel (19.3% Cr, 10.1% Ni, and 0.07% C) annealed at 900 and 1100°C. Micrographs and radiographs are compared and analyzed. Additional tests were made on the effects of additions of Ti (4%) to the chromium-nickel steel hardened in water at 1360°C. (R.V.J.)

10093

EFFECTS OF NIOBIUM ON THE TEMPERING FRIABILITY OF MANGANESE STEEL. I. V. Volobuev and V. V. Gavranek (Khar'kov Polytechnic Inst.).

Metalloved. i Termich. Obrabotka Metal. No. 2, 28-33 (1959) Feb. (In Russian)

The annealing friability of manganese steel with various contents of niobium was tested in a high-frequency furnace in vacuum and in atmosphere. It was found that niobium sharply reduces the tendencies to friability. The optimum content of niobium is 0.25%. (R.V.J.)

10094

IMPACT RESISTANCE OF 30HGS STEEL. S. S. Ermakov (Leningrad Polytechnic Inst.). Metalloved. i Termich. Obrabotka Metal. No. 2, 34-6 (1959) Feb. (In Russian)

Tests on the impact resistance of 30HGS steel (0.32% C, 1.16% Mn, 1.20% Cr, and 0.99% Si) tempered in oil at 880°C, annealed at 200 to 700°C, and air cooled showed two maximum tensile points at 200 and 400°C. (R.V.J.)

10095

THERMOMECHANICAL MACHINING OF STEEL OF 15 M AND 12 MH BRAND. A. P. Simakovskii. Metalloved. i Termich. Obrabotka Metal. No. 2, 40-4 (1959) Feb. (In Russian)

Tests on the thermomechanical properties of 12 MH steel (0.18% C, 0.30% Si, 0.61% Mn, 0.52% Cr, 0.37% Ni, 0.48% Mo) and 15 M steel (0.15% C, 0.33% Si, 0.49% Mn, 0.34% Cr, 0.46% Mo) at 480°C showed that 12 MH steel has a higher tensile strength; however, both have good mechanical resistance. (R.V.J.)

10096

EFFECTS OF TEMPERING ON THE STRUCTURE AND MECHANICAL PROPERTIES OF ALLOY ML5-T4. V. M. Babkin. Metalloved. i Termich. Obrabotka Metal. No. 2, 45-9 (1959) Feb.

The effects of repeated heating on the structure and mechanical properties of previously annealed alloy ML5-T4 (8.3% Al, 0.5% Mn, 0.001% Be) were studied at 175 to 400°C. Tempering at 200 to 350°C for 4 hours caused a sharp drop in mechanical properties of the alloy while continuous heating at 20 to 175°C and 400°C did not show any appreciable effects. (R.V.J.)

10097

FUEL ELEMENT PRODUCTION. Nuclear Eng. 4, 118-22 (1959) Mar.

The AEA's Springfield establishment for the production of fuel elements from concentrate to finished element is described. The new fluidized-bed process addition to the plant which is soon to be put into operation is discussed. Illustrations of various steps in the production and a simplified flow diagram are given. (W.D.M.)

10098

CERAMIC FUEL PRODUCTION IN FRANCE. Nuclear Eng. 4, 129-30 (1959) Mar.

To supply the needs of the development program and also any reactor incorporating ceramic fuels, CEA

placed a contract in Oct. 1957 with the Compagnie Industrielle des Ceramiques Electronique for the immediate construction of a UO₂ pellet production plant. The completed plant has a production capacity of 25 tons per annum and is designed to accommodate a uranium enrichment of up to 5%. (W.D.M.)

10099

PRODUCTION OF ALLOYS OF ALUMINIUM WITH PLUTONIUM, URANIUM OR THORIUM. (To U. K. Atomic Energy Authority (Canada).) British Patent 798,687. Nuclear Eng. 4, 146 (1959) Mar.

A halide salt (fluoride) of plutonium, uranium, or thorium mixed with excess aluminium is heated above the melting point of aluminium, in vacuo. The halide salt is reduced to the metal which alloys with aluminium while the aluminium halide is removed by distillation.

10100

PRODUCTION OF PLUTONIUM ALUMINIUM ALLOYS. (To U. K. Atomic Energy Authority (Canada).) British Patent 799,662. Nuclear Eng. 4, 146 (1959) Mar.

Plutonium oxide is mixed with cryolite and the mixture added to molten aluminium. The mass is maintained at 1050 to 1100°C to reduce the plutonium oxide and to alloy the plutonium and the aluminium.

10101

METHOD FOR ENCLOSING A URANIUM BODY IN A METALLIC SHEATH. (To U. K. Atomic Energy Authority.) British Patent 799,771. Nuclear Eng. 4, 146 (1959) Mar.

A mass of metal powder (beryllium, zirconium, tantalum, niobium, iron, copper, brass, bronze, or alloys of aluminium or beryllium) is compacted about a core of uranium metal, powder and core being above the beta-gamma transition point of uranium.

10102

BERYLLIUM FLUORIDES AND FLUOBERYLLATES. A. V. Novoselova. Uspekhi Khim. 28, 33-43 (1959) Jan. (In Russian)

Constitution diagrams of BeF₂ with alkali metals and divalent metals were studied and compared in order to determine the structure and thermal properties of beryllium fluoride and fluoberyllates. 72 references. (R.V.J.)

10103

RARE-EARTH BORIDE METALS. G. V. Samsonov. Uspekhi Khim. 28, 189-217 (1959) Jan. (In Russian)

The crystalline structure, properties, preparation, and uses of rare-earth boride metals and their alloys are reviewed. 72 references. (R.V.J.)

10104

HALL EFFECT IN ORDERED Fe-Al ALLOYS. A. V. Cheremushkina. Vestnik Moskov. Univ. Ser. Mat. Mekhan. Astron. Fiz. i Khim. 13, No. 1, 121-7 (1958). (In Russian)

Investigations of the Hall effect were carried out with prepared Fe-Al alloys (with 2.04, 3.99, 5.48, 7.48, 10.1, 11.56, 13.6, 14.8, and 16.0 wt. % Al). Electrodynamical forces were plotted for annealed and slowly cooled alloys with various content of Al. The ferromagnetic constant was found to be quite sensitive to structural changes. (R.V.J.)

10105

ELECTROCONDUCTIVITY OF LIQUID GALLIUM AND INDIUM. G. I. Goryaga and E. P. Belozerovala. Vestnik

Moskov. Univ. Ser. Mat. Mekhan. Astron. Fiz. i Khim. 13, No. 1, 133-6(1958). (In Russian)

The electric conductivity of liquid gallium and indium was measured at 156 to 450°C. (R.V.J.)

10106

WELDING OF EQUIPMENT FOR THE DRESDEN NUCLEAR POWER STATION. William R. Smith (General Electric Co., San Jose, Calif.). Welding J. (N. Y.) 38, 307-16(1959) Apr.

The Dresden Nuclear Power Station is being constructed about 50 miles southwest of Chicago. The service requirements of this plant necessitate the employment of a variety of materials and, in turn, many welding processes and methods. Several new and unusual as well as conventional welding techniques and applications are employed to produce the maximum integrity and reliability in the nuclear system. The materials of construction, welding materials, welding processes, and quality-control methods employed in the fabrication of the equipment in the nuclear portion of the plant are described. Schematic drawings and photographs are employed to help describe the fabrication and welding of the equipment. (auth)

10107

THE WELDING OF INCONEL FOR NUCLEAR-POWER APPLICATIONS. W. A. Fragetta and G. R. Pease (International Nickel Co., Inc., Bayonne, N. J.). Welding J. (N. Y.) 38, 347-56(1959) Apr.

It is becoming generally accepted that weldments used in nuclear-power reactor systems must meet more rigid quality standards than are required by most present-day codes and specifications. A demonstration that weldments can be produced to these standards has become an important part of the qualification procedure leading to the acceptance of any material used in the construction of nuclear components. In the present work, it has been demonstrated that, by the use of suitably controlled inert-gas processes and a titanium-manganese modified Inconel filler-wire composition, Inconel-tubed steam generators can be welded to conform to the desired quality levels. (auth)

10108

HIGH-TEMPERATURE BRAZING ALLOY-BASE METAL WETTING REACTIONS. W. Feduska (Westinghouse Electric Corp., East Pittsburgh, Penna.). Welding J. (N. Y.) 38, 122s-31s(1959) Mar.

Reactions between five high-temperature base metals and six high-temperature brazing alloys have been determined in three different atmospheres at nominal and superheat brazing temperature levels. The general effects produced by the variable test conditions have been reviewed to determine which combinations produced ideal and which produced poor wetting. In addition, relative "wetting index" ratings have been established for the 118 test combinations employed. Generally, the wettability of high-temperature alloys by brazing alloys decreased as the brazing temperature was increased above the nominal level. This behaviorism is attributed to an increase in reactivity between the brazing alloy elements and the base metal at the higher brazing temperature. (auth)

10109

THE MOLTEN ELECTROLYTIC PRECIPITATION OF TITANIUM METAL. Paul Ehrlich and Hubert Kühn (Univ. of Giessen, Ger.). Z. anorg. u. allgem. Chem. 298, 176-92(1959) Jan. (In German)

Metallic titanium was electrolytically deposited from lower valent titanium chlorides dissolved in molten alkali metal chlorides. The influence of titanium concentration, current density, and temperature is discussed. Very pure, coarsely crystalline Ti was obtained at 850°C by means of a large surface of the titanium anode and small distance between the electrodes. The existence of anionic Ti complexes in the melts was confirmed by measuring the polarization voltage and transference of titanium. (auth)

10110

CARBIDE PHASE OF NIOBIUM. Georg Brauer and Richard Lesser (Univ. of Freiburg i. B.). Z. Metallk. 50, 8-10(1959) Jan. (In German)

The binary system niobium-niobium carbide was re-examined. α , β , ζ , and δ phases were found between 1800 and 2000°C; the ζ phase was observed for the first time. It corresponds to the ζ phase in the system tantalum-carbon. The regions of existence and the structure of the phase (except ζ) were determined. Samples with very high carbide content proved thermally unstable; part of the carbon is precipitated after a heat treatment as graphite. The lattice parameter for the relatively stable NbC_{0.91}, the carbide with the highest carbon content, was determined as 4.4690 Å. (auth)

10111

EFFECT OF HEAT TREATMENT ON SOME PROPERTIES OF CORROSION-RESISTANT NICKEL-MOLYBDENUM ALLOYS. Karl Bungardt and Hans-Hermann Weigand (Deutsche Edelstahlwerke AG, Krefeld, Ger.). Z. Metallk. 50, 11-18(1959) Jan. (In German)

The effect of heat treatment on the microstructure, hardness, strength, and corrodibility was tested with four corrosion-resistant nickel-molybdenum alloys (with and without an addition of chromium). It was found that a change in these properties depends on the kind of precipitate which is formed during the heat treatment. The results are discussed. (auth)

10112

SINTERED HIGH-MELTING-POINT TUNGSTEN ALLOYS. Richard Kieffer, Karl Sedlatschek, and Horst Braun (Versuchsanstalt der Metallwerk Plansee AG, Reutte/Tirol, Austria). Z. Metallk. 50, 18-24(1959) Jan. (In German)

The significance of tungsten with respect to its high melting point and its position in the periodic table is discussed. The alloys of tungsten with some metals of the IVa and VIIa groups are discussed. A literature survey on qualitative investigations of tungsten alloys with titanium, zirconium, and chromium with alloying additions from 1 to 10% is given, and the results of the present experimental investigations are reported. From melting curves and lattice parameters, the tungsten-vanadium system appears to be similar to the chromium-molybdenum alloy. The systems of tungsten with niobium and tantalum were thoroughly investigated, and the properties of the alloys such as density, hardness, specific electrical resistance, and corrosion behavior are described. (tr-auth)

10113

THE FORMATION OF INTERNAL OXIDATION ZONES IN SILVER-INDIUM ALLOYS. Isolde Dietrich and Lisl Koch. Z. Metallk. 50, 31-5(1959) Jan. (In German)

The internal oxidation of silver-indium alloys was investigated. The subscales were produced by anneal-

ing in the air. For proving the internal oxidation, either polished and etched cross sections of the samples were studied metallographically or resistance measurements were taken. The effect of indium concentration, annealing time, and annealing temperature on the subscale growth was investigated. In agreement with theoretical considerations of F. N. Rhines, a parabolic time law and an exponential temperature dependence was found for indium concentrations below 6 wt.% and annealing temperatures above 400°C. (auth)

10114

THE LITHIUM-SILICON SYSTEM. Horst Böhm (Metall-Laboratorium der Metallgesellschaft AG, Frankfurt am Main). *Z. Metallk.* **50**, 44-6(1959) Jan. (In German)

The constitution of the lithium-silicon system was investigated by thermal analysis. A compound Li_4Si (or $\text{Li}_{15}\text{Si}_4$) is formed peritectically at $633 \pm 5^\circ\text{C}$. Li_2Si melts without decomposition at $752 \pm 5^\circ\text{C}$. An eutectic is formed of Si and Li_2Si at 39.4 ± 0.5 atom % Si and $635 \pm 5^\circ\text{C}$. (auth)

10115

THE PRODUCTION OF RESISTANCE LAYERS IN ALUMINUM ANTIMONIDE ACCORDING TO THE ALLOYING METHOD. Hans-Joachim Henkel (Siemens-Schuckert-Werke AG, Erlangen, Ger.). *Z. Metallk.* **50**, 51-3(1959) Jan. (In German)

It is shown that AlSb can be contacted with aluminum foil melted to the sample. A p-n junction with n-conducting AlSb appears when a small amount of zinc is added to the foil material. Crystallization zones can be made visible by etching. Potential measurements prove that the p-n junction is located at the boundary between the n-conductor and the crystallization zone, which is a p-conductor because of the zinc content of the electrode. (auth)

10116

SLIPPING OF BERYLLIUM SINGLE CRYSTALS AT LOW TEMPERATURES. R. I. Garber, I. A. Gindin, Yu. V. Shubin (Inst. of Physics and Tech., Academy of Sciences, Ukrainian S.S.R.). *Zhur. Eksptl' i Teoret. Fiz.* **36**, 376-84(1959) Feb. (In Russian)

Especially pure (99.98%) beryllium single crystals were deformed at 20 and 77°K. Slipping along the basis plane (0001) was detected at 20 as well as at 77°K. Two deformation stages are discerned: the initial stage when the displacement occurs in a thin layer adjacent to the slipping pole and a later stage when the deformation is localized at the slipping pole. In regions between the poles a turn rotation was detected which increases with the deformation. The rotation twist of the blocks in the early stages may be ascribed to the effect of residual strains. In the later stages when the rotation reaches 3° one is forced to assume that twinning takes place during slipping. The large magnitude of the relative displacement in the second stage may be explained by violation of continuity with subsequent restoration of the contacts. (auth)

10117

ON THE THEORY OF FORMATION OF SOLID SOLUTIONS OF METALLIC SYSTEMS. A. N. Krestovnikov and V. N. Vigdorovich (Kalinin Inst. of Non-Ferrous Metals). *Zhur. Fiz. Khim.* **33**, 78-82(1959) Jan. (In Russian)

A systematization was made of experimental data on systems in which an increase in the temperature sta-

bility of the basic component takes place on the formation of a solid solution on its basis. The material was analyzed from the standpoint of the nature of the electronic structure of the atoms of the interacting elements. (auth)

10118

SELF-DIFFUSION IN SOLID LITHIUM. A. N. Naumov and G. Ya. Ryskin (Leningrad Inst. of Physics and Tech.). *Zhur. Tekh. Fiz.* **29**, 189-91(1959) Feb. (In Russian)

The stable isotope method was used for measuring the self-diffusion coefficient of solid lithium in the temperature range 70 to 170°C. The temperature dependence of self-diffusion is described by the equation $D = 0.39 \times \exp(-13490/RT)\text{cm}^2/\text{sec}$. (R.V.J.)

10119

EFFECT OF A SURFACE-ACTIVE MEDIUM ON THE DEFORMATION OF METALS. V. I. Likhtman, P. A. Rebinder, and G. V. Karpenko. Translation of "Vliyaniye Poverkhnostno-Aktivnoi Sredy na Protsessy Deformatsii Metallov." London, Her Majesty's Stationery Office, 1958. 195p.

Work by Russian scientists on the effects of environment, in particular liquid surface-active media, on the mechanical properties of metals is reported. Information is included on the following: methods of growing single crystals and their mechanical properties; rules governing the deformation of single crystals in the presence of surface substances; creep of single crystals and electrocapillary effect; effect of surface-active media on the mechanical properties of polycrystalline metals; corrosion and adsorption fatigue of metals; principal mechanisms governing the adsorption fatigue of metals; and physicochemical effects during pressing and sintering of metal powders. (J.H.M.)

10120

URANIUM-PART I, URANIUM GENERAL, 1942-1958. CTR-365. Washington, Office of Technical Services, 1958. 16p. \$0.10.

This catalog of technical reports on uranium is the result of research conducted for the Army, Navy, Air Force, Atomic Energy Commission, and other U. S. Government agencies. Other reports are German documents captured by the Allies during World War II. (J.E.D.)

10121

URANIUM-PART II, ALLOYS AND COMPOUNDS, 1936-1958. CTR-366. Washington, Office of Technical Services, 1958. 14p. \$0.10.

This catalog of technical reports on uranium alloys and compounds is the result of research conducted for the Army, Navy, Air Force, Atomic Energy Commission and other U. S. Government Agencies. Other reports are German documents captured by the Allies during World War II. (J.E.D.)

PARTICLE ACCELERATORS AND HIGH-VOLTAGE MACHINES

10122 CERN-59-2

European Organization for Nuclear Research, Geneva. PRODUCTION OF PLASMA IN A TOROIDAL VESSEL BY MEANS OF A SPIRAL ELECTRON BEAM. J. G. Linhart and L. Th. M. Ornstein. Jan. 1959. 12p.

This method aims at a large degree of ionization at pressures below 10^{-4} mm Hg. An electron beam drawn from a cathode is made to follow a spiral path in a magnetic field. A plasma generation mechanism is described which is capable of producing linear densities of the order of 10^{11} electrons per cm at pressures of a few times 10^{-6} mm Hg. These are suitable values for plasma betatron experiments. (W.D.M.)

10123 INSJ-15

Tokyo Univ. Inst. for Nuclear Study.

MAGNETIC PROPERTIES OF YOKE BLOCKS FOR INS-J 1 Bev ELECTRON SYNCHROTRON. H. Sasaki, S. Yamaguchi, Y. Kobayashi, R. Yamada, H. Kumagai, and T. Yamakawa. Jan. 16, 1959. 26p. (INS-TH-32).

The full-scale model magnet of INS-J 1 Bev electron synchrotron was used for examining the properties of yoke blocks and pole pieces in static and dynamic field. Yoke blocks consist of 0.35 mm silicon steel plates cemented with Araldite, the thickness having been 100 mm in the initial design. The measurements on these blocks showed a large azimuthal field variation, which might have been caused by mechanical stress introduced under thermal treatment in cementing. The thickness of yoke blocks was decreased to 25 mm. The measurement of these thin blocks showed that the field variation was much reduced. (W.L.H.)

10124 NP-7342

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.

THE THEORY OF PARTICLE CAPTURE INTO SYNCHROTRON ACCELERATION REGIME WITH ACCOUNT OF NONCONSERVATION OF MOTION EQUATIONS. V. K. Melnikov and Yu. S. Sayasov (Sajasov). 1958. 14p.

A calculation of the capture region for accelerators is given taking into account the nonconservation of the equation of motion of the particles. The calculation is based upon the assumption that the change of $m(t)$ and $f(t)$ is slow in the equation $d/dt [m(t)\dot{\psi}] + f(t)U^2(\psi) = 0$. (W.D.M.)

10125 UCRL-8578

California. Univ., Berkeley. Lawrence Radiation Lab. RADIOFREQUENCY SYSTEM FOR EXTRACTING PARTICLES FROM A CYCLOTRON. Warren Fenton Stubbins. Sept. 1958. 13p. Contract W-7405-eng-48. \$0.50(OTS).

The impressive rate of particle loss by vertical beat-frequency (VBF) blowup in the low electrical field of a synchrocyclotron suggests the application of a radio-frequency perturbation to induce growth of radial oscillation amplitude for beam extraction. The use of an electrical field with a linear gradient on the outward side of a reference orbit and extending 60° in azimuth has been studied. The radiofrequency is chosen to make radial oscillations, described by an equation of the Hill type, unstable. Orbit calculations for a cyclotron with 50-Mev deuterons in a 17,000-gauss field have been made on a digital computer. Two essential features were observed: (a) a reasonable separation between successive turns influenced by the perturbation, and (b) a phasing of orbits so that the maxima following an increase in amplitude occur near one azimuth. An electrical gradient of 4.3 kv/cm² was used in the computations. The application of this system to variable-energy constant-frequency cyclotrons and very-high-energy accelerators is under study. The possibility of changing the electrical frequency and gradient to match operating conditions eliminates difficulties arising in magnetic

extraction systems for variable-energy machines. (auth)

10126

12.5 Bev PROTON SYNCHROTRON TO GO CRITICAL IN '62. Robert W. Heath. Ind. Labs. 10, No. 3, 47-8 (1959) Mar.

The Argonne National Laboratory 12.5-Bev proton synchrotron and its associated experimental facilities are described. (T.R.H.)

10127

MEASUREMENT OF THE BREMSSTRAHLUNG SPECTRUM FROM A 30 Mev BETATRON WITH A COMPTON ELECTRON SPECTROMETER.

U. Miklavžič and Č. Supančič. "J. Stefan" Inst. Repts. (Ljubljana) 5, 3-8 (1959) Oct.

The bremsstrahlung spectrum from the Brown-Boveri betatron was measured at 30 Mev using a magnetic Compton electron spectrometer. The measuring procedure was to determine the electron spectrum, positron spectrum, and the corresponding background. The experimental arrangement is explained. (W.D.M.)

10128

ADJUSTABLE GAS LEAK. V. Ivković and G. Mavrodiev. "J. Stefan" Inst. Repts. (Ljubljana) 5, 29-31 (1958) Oct.

An adjustable gas leak, developed for the ion source of a 2 Mv Van de Graaff accelerator, is described in detail. The control of the flow rate is obtained by the thermal expansion of a metal wire, heated by a small electric current. The functioning of the leak and its properties is compared with the other types of leaks, used commonly for the same purpose. (auth)

10129

IMPROVED CYCLOTRON PERFORMANCE FROM CONTROL OF INITIAL ION MOTION. A. H. Morton and W. I. B. Smith (Australian National Univ., Canberra). Nuclear Instr. & Methods 4, 36-43 (1959) Jan.

Techniques have been developed to improve cyclotron beam characteristics by the use of slits near the ion source to obtain defined internal beams concentric with the cyclotron center resulting in high extraction efficiencies and monoenergetic external beams of small angular spread. The optics of the ion source and the use of focusing grids on early revolutions of the ions are discussed. (auth)

10130

ACTUAL STATE OF THE CONSTRUCTION FOR THE NATIONAL 1000-Mev ELECTRON SYNCHROTRON. G. Salvini (Univ. of Rome). Nuovo cimento (10) 9, Suppl. No. 2, 402-15 (1958). (In Italian)

The stage of construction of the Italian 1000-Mev electron synchrotron is reported. The magnets, focusing coil, magnetic measurements, injector, vacuum and annulus, radiofrequency, and entry of electron beam are considered. The experimental auxiliaries are also discussed. (J.S.R.)

PHYSICS AND MATHEMATICS

General

10131 AD-210757

Saint Louis Univ.

FEASIBILITY STUDY OF TEMPERATURE AND DEN-

SITY MEASUREMENTS IN GASES USING THERMAL NEUTRON SCATTERING. Final Technical Report. R. M. Delaney and A. H. Weber. Jan. 31, 1959. 19p. Project title: FEASIBILITY STUDY OF THERMAL NEUTRON SCATTERING MEASUREMENT WITHIN SMALL VOLUME ELEMENTS OF IONIZED GASES. Contract DA-23-072-ORD-1295.

Two methods of using thermal neutrons to determine temperature and density distributions in high-temperature plasmas have been appraised. An indirect but technically feasible method suggested by an article by Brockhouse and Hurst is described, which involves collimating incoming and outgoing neutron beams to select neutrons of a certain energy distribution and scattered into a particular solid angle. A simple transmission experiment can be performed with the scattered neutron beam utilizing an analyzing material (Cd, Sc, or B), and a measurement of particle density can be made by replacing the plasma by a monatomic gas (H) of known density and temperature. (auth)

10132 AERE-C/R-2199

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. ISOTOPIC ANALYSIS BY LOW-RESOLUTION NUCLEAR MAGNETIC RESONANCE. D. J. Ferrett and F. D. Seymour. Mar. 11, 1957. 25p.

Low-resolution nuclear magnetic resonance offers a method for the analysis of liquid samples of H^1 , F^{19} , and Be^{11} and other isotopes with spin quantum numbers. The method is nondestructive, reasonably accurate (1 to 3%), and rapid. (W.L.H.)

10133 AERE-RE/R-1486

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. LINEAR INCREASES IN PILE REACTIVITY, ANALOGUE COMPUTER RESULTS. T. E. Burnup. Aug. 20, 1954. 12p.

Solutions are given for the reactor kinetic equations for a linear increase in reactivity (2×10^{-5} to 100×10^{-5} in k per second) applied to the start up of a graphite-uranium reactor. The relation between power range, reactivity, and reactivity rate is given for 12 decades above spontaneous power. (auth)

10134 AERE-T/R-1295

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England. THE SPHERICAL HARMONICS METHOD IN PLANE AND SPHERICALLY SYMMETRIC GEOMETRY IN MULTI-VELOCITY-GROUP THEORY, AND ITS APPLICATION IN THE TWO-VELOCITY-GROUP P_3 APPROXIMATION. M. E. Mandl. Nov. 1953. 14p.

The spherical harmonics method is extended to a multi-velocity group theory and is illustrated by application to a two-velocity group theory in P_3 approximation, in spherical and in plane symmetrical geometry. The method is applied, in the 2-group P_3 approximation, to finding the critical radius of a spherical core surrounded by a tamper of uniform thickness, and the critical thickness of an infinite slab core with equal thicknesses of tamper on each side. (auth)

10135 AFOSR-TR-58-125

Air Research and Development Command, [Baltimore]. CONFERENCE ON ION AND PLASMA RESEARCH AT THE UNIVERSITY OF MARYLAND, COLLEGE PARK,

MARYLAND, SEPTEMBER 30-OCTOBER 2, 1958. 77p. (AD-162274). \$2.00(OTS).

Abstracts of papers presented at the conference on ion and plasma research are given. The status and progress of the various programs are summarized. Fifty-six Air Force sponsored projects are reported on. (W.D.M.)

10136 AFOSR-TN-58-833

Stanford Univ., Calif. A NEW CALCULATION OF THE NUMERICAL VALUE OF THE LAMB SHIFT. Technical Report No. 41. C. Schwartz and J. J. Tiemann. Sept. 1958. 17p. Project No. 3750-37504. Contract AF18(600)-545. (AD-202918).

The calculation of the second-order perturbation in hydrogen which gives the low-energy part of the Lamb Shift is attacked from a new approach. A formula is derived for $\ln(k_0)$ involving a double integral. The final numerical evaluation using an electronic computer to sum the series expansion of this formula yields what is believed to be the most accurate value of $\ln(k_0)$ yet given. Small discrepancies with the earlier results of Harriman are outside the realm of current physical significance, but do indicate that the reliability of the earlier results was badly overestimated. Approximate formulas for the radiative-perturbed wave functions are given; these may be quite useful for further calculations. (auth)

10137 AFOSR-TN-58-1005

Maryland. Univ., College Park. Inst. of Molecular Physics. MOBILITY OF HYDROGEN IONS (H^+ , H_2^+ , H_3^+) IN HYDROGEN. Edward A. Mason and Joseph T. Vanderslice. Nov. 14, 1958. 24p. Contract AF18(600)-1562. (IMP-OSR-11; AD-206148).

Force laws for H^+ , H_2^+ , and H_3^+ in H_2 are calculated from theory and from results on the scattering of low-velocity ion beams in H_2 gas. These results are then used to calculate the mobilities of the hydrogen ions in H_2 gas as a function of temperature. The mobilities of H^+ and H_2^+ decrease slightly with increasing temperature, but the mobility of H_3^+ increases strongly. The agreement with experiment indicates that the unidentified hydrogen ion whose mobility has been measured is probably H_2^+ , rather than the usually assumed H_3^+ . (auth)

10138 AFOSR-TN-58-1133

California. Univ., Berkeley. ON THE DEVELOPMENT OF GASEOUS DETONATION. III. IONIZATION WORLD LINES. Technical Note DR 3. G. J. Hecht, A. J. Laderman, R. A. Stern, and A. K. Oppenheim. Jan. 1959. 62p. I.E.R. Project No. 96895. Contract AF49(638)-166. (AD-208082).

The design and construction of an ionization detection circuit to measure ionization world lines during the development of detonation are described. The ionization processes occurring in flames, shocks, and detonations are reviewed. A critical survey of existing ionization gages is made. The evaluation of performance criteria for the present purpose is described and the design of the gage and electronic apparatus reported. The operation of the instrument is demonstrated by means of experiments performed with stoichiometric hydrogen-oxygen mixtures. It appears that the apparatus is a reliable and sufficiently accurate instrument for the measurement of ionization world lines during the development of detonation and that it can be adjusted so that within most of the operating range it registers the world lines of the flame front. (auth)

10139 APEX-452(Rev.)

Computer Usage Co., Inc., New York.

CURE: A TWO-SPACE-DIMENSION, MULTI-GROUP CODE FOR THE IBM-704. F. M. Trantham, Jr.

Aug. 12, 1958. 137p. For General Electric Co. Aircraft Nuclear Propulsion Dept. Contracts AF33(600)-38062 and AT(11-1)-171. \$2.75(OTS).

Replaces APEX-452. Pages inadvertently omitted in the previous edition are included and several changes have been made in the text. For abstract see NSA, Vol. 13, abstract No. 5648.**10140 APEX-461**

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

OFF-CENTER CONTROL ROD PROGRAM (DIGITAL COMPUTER PROGRAM K). C. L. Moore. Feb. 1959. 131p. Contracts AF33(600)-38062 and AT(11-1)-171. \$2.75(OTS).

Digital computer Program K constructs the two energy-group analysis of a cylindrical reactor core with an off-center control rod. Solutions are constructed for the fast and slow neutron flux in terms of rod-centered cylindrical coordinates and also in terms of core-centered cylindrical coordinates. The effect of the control rod is expressed in terms of fast and slow albedos at the rod-core interface. The boundary conditions at the core outer surface are expressed in terms of energy-averaged flux logarithmic derivatives at the radial core reflector interface and at the end core reflector interfaces. Program K calculates the reactivity worth of the off-center control rod, calculates fast flux, slow flux, and relative power density at rod-centered and core-centered mesh points, and produces cathode-ray-tube plots of fast flux and/or slow flux and/or relative power density versus radius or angle in either the rod-centered or the core-centered coordinate system. The input for Program K consists of geometric and physical parameters for the control rod and reactor core, data specifying rod-centered and core-centered mesh points, and data specifying the CRT plots desired. The physics and mathematics of the problem, the numerical analysis used in formulating the program computations, and the program are discussed. (auth)

10141 APEX-471

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

PROCEEDINGS OF THE LARGE-CRYSTAL SPECTROMETRY SYMPOSIUM HELD IN CINCINNATI, OHIO, MAY 23, 1958. J. G. Carver, comp. Mar. 2, 1959. 75p. Contracts AF33(600)-38062 and AT(11-1)-17. \$2.25(OTS).

An informal symposium was held on the subject of gamma-ray spectroscopy through the use of large (i.e., on the order of 9×9 in.) single crystals of sodium iodide (Tl activated), and as much of the proceedings as could be gleaned from a recorded set of minutes are presented. Results of the conference are summarized by Prof. R. Hofstadter. (W.D.M.)

10142 CF-58-7-9

Oak Ridge National Lab., Tenn.

ANALYSIS OF TAPERED CIRCULAR PLATES. F. J. Stanek. Mar. 18, 1959. 50p. Contract [W-7405-eng-26]. \$7.80(ph), \$3.30(mf) OTS.

Tables of numerical values of all necessary functions and instructions on their use in the stress analysis of circular plates which have a linear thickness-radius relationship, and which are loaded axisymmetrically, are

presented. The analysis is based on the classical small-deflection theory. Emphasis is placed on plates whose thickness at the inner radius is greater than the thickness at the outer radius. However, a limited number of plates for which the opposite is true may also be analyzed by the procedure presented. The limitations on the dimensions of the latter type of plate are explained. (auth)

10143 CF-58-11-77

Oak Ridge National Lab., Tenn.

RECENT ADVANCES IN GAS ABSORPTION APPARATUS IN RUSSIA. J. T. Long. Feb. 16, 1959. 34p. Contract W-7405-Eng-26. \$6.30(ph), \$3.00(mf) OTS.

A survey was made of articles dealing with gas-liquid contacting appearing in Russian chemical engineering publications of the last decade. The mechanism of absorption under the nonideal conditions encountered industrially was studied and the theory advanced that absorption kinetics was a function of the time required for renewal of surface layers. The hydrodynamics of gas passage through a liquid was examined with respect to number, size, and shape of bubbles and rates of bubble ascent. The depth of the dynamically stable gas-liquid foam layer was determined for various conditions of initial liquid depth, physical properties of the liquid, and size and spacing of plate perforations. Equipment was developed which operates in the foam regime rather than in the bubble regime and has a lower pressure drop for a given effectiveness. A dynamically stable foam is produced which has a high gas content and a high degree of turbulence. Data are reported on mass transfer, heat transfer, and removal of dusts or mists from gases in foam apparatus. (auth)

10144 D2-1755

Boeing Airplane Co., Seattle.

COSMIC-RAYS AND SUB-NUCLEAR PARTICLES. C. J. DeZeh. [Feb. 1957]. 47p.

The purpose of this study was to collect information which will be required for aircraft design criteria considerations in the future. The status of knowledge relating to cosmic rays and atmospheric subnuclear particles is reviewed. Data are presented setting forth some of the properties of these, as well as factors causing perturbations. Conclusions are given. (W.D.M.)

10145 EMRL-13

Brown Univ., Providence. Engineering Materials Research Lab.

ENERGY VERSUS STRESS THEORIES FOR COMBINED STRESS—A FATIGUE EXPERIMENT USING A ROTATING DISC. W. N. Findley, P. N. Mathur, E. Szczepanski, and A. O. Temel. FINAL REPORT ON BASIC RESEARCH ON FATIGUE FAILURES UNDER COMBINED STRESS. W. N. Findley. Dec. 1958. 25p. Project No. 5B99-01-004. Contract DA-19-020-ORD-3520. Technical Report No. 7. (AD-209372).

An experiment is described in which the strain energy at the critical location for fatigue failure is maintained constant while the stresses on a given plane of the material at the same location are caused to fluctuate. Apparatus developed to produce this condition consisted of a circular disk with a wide-flanged rim which was loaded along a diameter by means of pivot-pad bearings. The disk was then rotated under a constant load to produce the desired fluctuation in stresses at the center of the disk while maintaining a constant strain energy at the center. The fact that fatigue cracks were developed in the region of constant strain energy

was considered to indicate that a concept of a fluctuating strain energy as a basic theory of failure by fatigue under combined stresses is not tenable. (auth)

10146 HW-58497

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE EFFECT OF TEMPERATURE ON THE NEUTRON ATTENUATION OF MAGNETITE CONCRETE. D. E. Wood. Dec. 11, 1958. 27p. Contract W-31-109-Eng-52. \$1.00(OTS).

The neutron attenuation of magnetite concrete is measured after heating the concrete to 100, 200, and 300°C. The experimentally determined relaxation lengths are compared to the value calculated from the concrete composition. Transverse streaming effects and temperature distributions are reported. (auth)

10147 HW-59546

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

SIMULATION OF AN ELECTROMAGNETIC NONDESTRUCTIVE TEST ON AN ANALOG COMPUTER. W. D. Cameron. Mar. 9, 1959. 14p. Contract W-31-109-Eng-52. \$3.30(ph), \$2.40(mf) OTS.

The purpose of this research is to show the impedance of an approximate equivalent circuit on a complex plane for various constant frequencies and different metals. The equivalent circuit represents a testing coil driven with a-c voltage and a network to represent the impedance of the metal. (W.L.H.)

10148 KAPL-M-GHE-2

Knolls Atomic Power Lab., Schenectady, N. Y. APPLICATION OF DIGITAL COMPUTERS TO THE ANALYSIS OF RADIOACTIVE TRANSPORT PROBLEMS. G. H. Epstein. Nov. 14, 1958. 34p. Contract W-31-109-Eng-52. \$6.30(ph), \$3.00(mf) OTS.

Accessibility to reactor power plant equipment for maintenance and repair may be hindered by deposited radioactivity. Difficulty in controlling this deposit better derives from the lack of understanding of physico-chemical processes which cause radioactive corrosion products to deposit on non-radioactive surfaces. For this reason, primary impetus has been given to in-pile experimental programs. Emphasis should also be given to the use of analytical techniques in support of the experimental programs. Some work done using the SFO code and IBM 704 computer as tools for inferring rate process phenomena from experimental information is described. A simple 4-node picture of the reactor plant employing transport coefficients in the form of probabilities, was used in making parameter studies and in attempting to match activities observed in operating reactor plants. Although the early activation model was not successful in matching all observed activities, the results show that the 704 computer could be used as a data analyzer for in-pile loops or reactor plants. Improved models are discussed. (auth)

10149 LA-2161

Los Alamos Scientific Lab., N. Mex.

A ONE DIMENSIONAL INTERMEDIATE REACTOR COMPUTING PROGRAM. C. B. Mills and F. Brinkley. Mar. 1957. 99p. Contract W-7405-eng-36. \$2.50 (OTS).

The familiar age diffusion equation was written in a very flexible form for numerical integration on a fast digital computing machine (IBM-704). One dimensional slab, sphere, or cylinder geometries in an annular homogeneous multiregion configuration may be computed

with hydrogen, continuous slowing down, and inelastic scattering. The numerical approximations are:

$$\nabla^2 \phi = \frac{\bar{\phi}_{n+1} - 2\bar{\phi}_n + \bar{\phi}_{n-1}}{(\Delta r)^2}$$

$$d\bar{\phi}/dr = \frac{\bar{\phi}_{n+1} - \bar{\phi}_{n-1}}{2\Delta r}$$

$$\bar{\phi}^i = \frac{\phi_1^i + \phi_2^i}{2}$$

in each lethargy group i . The eigenvalue $\nu = (\iint F(n,u)du dV)^{-1}$, where F is the normalized fission density, fission distribution, flux ($\bar{\phi}_n$ at each space point n and lethargy group i), and neutron conservation numbers are computed for the converged condition (on the iterated fissioning distribution). Time for a multiregion (10 or less), multigroup (34 or less) solution is approximately 1 to 2 minutes. Both the treatment of the equation and program details are presented. (auth)

10150 NAA-SR-Memo-1343

North American Aviation, Inc., [Downey, Calif.].

A METHOD FOR DETERMINING THE EQUILIBRIUM DISTRIBUTION OF ELECTRONS AND THEIR TOTAL FREE ENERGY IN A MULTIVALENT METAL. G. W. Lehman. April 14, 1955. 6p. \$1.80(ph), \$1.80(mf) OTS.

It is shown that the problem of determining the most probable distribution of valence electrons over the one-electron states and their total electronic free energy in a multivalent metal can be rigorously solved in the Hartree-Fock approximation. The distribution of valence electrons is given by the ordinary Fermi function. (auth)

10151 NP-7353

Carnegie Inst. of Tech., Pittsburgh.

ELECTRIC FIELD DISTRIBUTION IN AN IONIZED GAS. [PART] I. Technical Report No. 1. Michel Baranger and Bernard Mozer. [1958?]. 19p. Contract Nonr-760(15).

A method for improving systematically the Holtsmark distribution is described. It is based on a cluster-type expansion and takes into account increasing orders of correlation. It is applied to the calculation of the distribution of the high-frequency component of the electric field in an ionized gas in thermal equilibrium. (auth)

10152 NP-7356

Westinghouse Electric Corp. Research Labs., Pittsburgh.

EFFECT OF CAP RIGIDITY ON STRESSES IN A PERFORATED HEMISPHERICAL HEAD. Research Report 100FF996-R5X. Robert C. Sampson. Sept. 29, 1958. 19p.

A flanged hemispherical head with a circular arrangement of thirteen holes was tested by the photoelastic "frozen stress" technique. Hole caps of three different rigidities were employed and found to have a pronounced effect on the maximum stresses in the vicinity of the holes, but little effect at a short distance from the holes. The maximum stress at the boundary of a hole that is not reinforced by a cap was determined, by extrapolation, to be as much as 15 times the internal pressure. That peak would occur at the inner surface of the hemisphere in the narrowest section of a ligament between holes. Holes with very rigid caps, not attached near either surface of the hemisphere, may sustain a maximum stress that is only about 10 times the internal pressure. (auth)

10153 NYO-2539

New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center. ON THE INVERSION OF CERTAIN MATRICES. Samuel Schechter. Feb. 1, 1959. 16p. Contract AT(30-1)-1480. \$3.30(ph), \$2.40(mf) OTS.

Properties of matrices of the form $H = \{(a_i - b_j)^{-1}\}$ are investigated. If $G = H^{-1} = c_{ij}$ then explicit formulas are given for $\{c_{ij}\}$, and the row and column sums of G . These extend formulas previously given by Collar and Smith for the generalized Hilbert matrix. For H symmetric and positive definite the smallest eigenvalue of H and its P -condition are estimated. (auth)

10154 PR-P-40

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

PROGRESS REPORT [FOR] OCTOBER 1 TO DECEMBER 31, 1958. 74p. (AECL-770). \$1.50(AECL).

A program of study of the conversion lines accompanying the decay of Ce^{144} , Tb^{160} , and Np^{239} was carried out using the new $\pi\sqrt{2}$ beta spectrometer. The results lead to level schemes, together with spin and parity assignments, for the daughter nuclei. A study is being carried out to examine the role played by low energy nuclear physics in the evolution of the stars and the formation of the elements. A detailed study of the frequency-wavelength relation for elastic waves traveling in single crystals of silicon and sodium iodide was accomplished using the new neutron diffraction crystal spectrometer at the NRU Reactor and the rotating crystal spectrometer at NRX. Measurements on the coherent elastic scattering of neutrons from a single crystal of lithium hydride were made. A program for calculating the amount of plutonium and its isotopic constitution in sections of irradiated fuel rods was written. A new method of approximating to the solution of the neutron transport equation was developed. The oscillator nucleus model frequently used in nuclear physics calculations was checked with a self-consistency calculation using the Hartree-Fock system of equations. The polarization of high energy protons scattered from the low excited states of C^{12} and Be^9 was calculated using shell model states in the L-S coupling limit. A gamma insensitive neutron counter is being developed and a new type of particle detector based on the use of semiconductor junctions is being explored. Developments in electronics are discussed. (For preceding period see PR-P-39.) (W.D.M.)

10155 SCDC-802

New Mexico Coll. of Agriculture and Mechanic Arts, State College. Physical Science Lab.

A METHOD FOR OBTAINING THE VARIANCE OF AVERAGES OVER NON-INDEPENDENT SAMPLES FROM A STATIONARY TIME SERIES. Peter D. Welch. Dec. 19, 1955. Changed from OFFICIAL USE ONLY Feb. 6, 1959. 15p. For Sandia Corp. \$3.30(ph), \$2.40(mf) OTS.

A method is presented for obtaining the variance of averages over nonindependent samples from a stationary time series. The problem is stated, a derivation of a solution is presented, and general applications of the method are discussed. Specific applications are included as illustrations. These include the derivation of the law of large numbers and the large sample solution for a low-frequency concentrated straight-line spectrum. Observations are included concerning spectra whose variances are concentrated at high frequencies. (C.H.)

10156 UCRL-5412-T

California, Univ., Livermore. Lawrence Radiation Lab.

HIGH TEMPERATURE CLASSICAL EQUATION OF STATE. B. J. Alder and E. B. Smith. Nov. 1958. 35p. Contract W-7405-eng-48. \$0.50(OTS).

A study is made of the effect of potential perturbations on the equilibrium properties of a hard sphere system at both high and low densities. The perturbation is evaluated beyond the first order term for the second and third virial coefficients to estimate the region of convergence. The results of the first-order perturbation from the virial expansion, superposition theory, and free volume theory are compared. A comparison with experimental data is made to show the applicability of this perturbation from a hard sphere potential to the estimation of the equilibrium properties of a great variety of gases at moderately high temperatures. (auth)

10157 UCRL-8545

California, Univ., Berkeley. Lawrence Radiation Lab. PHYSICS DIVISION SEMIANNUAL REPORT [FOR] MAY THROUGH OCTOBER 1958. Dec. 10, 1958. 86p. Contract W-7405-eng-48. \$2.25(OTS).

Operation and development of liquid hydrogen bubble chambers are discussed. Meson (K^-) absorption in deuterium and interactions in hydrogen are discussed. Approximately 70 meson (K^-) decay-like events are categorized. Data are tabulated from 128 Σ^- decays. Analysis of Σ^- decays in which the decay product produces a track of near-minimum ionization is continuing. Measurements on K^- and Σ^- masses are reported. A study of hyperons produced in K^- meson interactions is continuing. Preliminary results from the analysis of K^+ decay modes were obtained. A number of gas-filled Cherenkov counters were built. Meson (π^+) production in $\pi^- + p$ reactions was studied. A new scheme for analyzing nucleon-nucleon scattering experiments was developed and applied to p-p scattering data at 310 Mev. Elastic scattering of antiprotons from complex nuclei is discussed. Applications of dispersion relations to strong-coupling physics and classification and interaction schemes for elementary particles are discussed. Design studies for the 88-in. cyclotron are reported. Computer codes for bubble chamber data reduction, cyclotron design, and miscellaneous items are described. An experiment on x rays from K-mesic atoms was conducted. A search for particles in the mass band 450 to 650 m_e was conducted. An experiment to identify an antineutron beam is described. Polarization of protons from Λ^0 decay was investigated. Studies were made of the cross section and polarization in scattering of 415-Mev deuterons by Be and C. Polarization of the recoil proton in $\pi^+ - p$ scattering at 310 Mev was investigated. The prototype of an apparatus for displaying the intensity distribution in external charged particle beams was tested at the 184-in. cyclotron. A major effort was directed toward obtaining reliable performance from commercial mercury diffusion pumps. Development and operation of accelerators and components are summarized. (For preceding period see UCRL-8281.) (W.D.M.)

10158 AEC-tr-3538

STUDY AND DEVELOPMENT OF A HIGH FREQUENCY ELEVATED DISCHARGE ION GUN. (Etude et Realisation d'un Canon à Ions du Type Haute Fréquence à Débit Élevé.) J. Coutant, F. Prevot, and R. Vienet. Translated for Oak Ridge National Lab. from report PA/7737, 1958. 89p. \$13.80(ph), \$4.80(mf) JCL or LC. Development of a high-frequency Thonneman source

is described in which the proportion of monoatomic ions amounts to about 95%. Operation of the various components of the source is described, and a performance estimate of the aggregate is given. The values of consumed power, hourly gas flow, and the relaxation for the target currents from 0.5 to 8 ma are plotted. The source is capable of furnishing up to 12 ma. It has been in operation for 150 hours at report time. (J.R.D.)

10159 AEC-tr-3561

CALCULATION OF PLANE PARALLEL AND AXIAL SYMMETRICAL ELECTROSTATIC FIELDS. G. V. Der-Shvarts and K. A. Netrobenko. Translated by A. L. Monks (Oak Ridge National Lab.) from *Elektrichestvo*, No. 5, 51-4 (1959). 13p. (Includes original, 4p.) \$3.30(ph), \$2.40(mf) JCL or LC.

A solution of the Laplace equation may be obtained with a high degree of accuracy on a discreet computer. However, a calculation of the fields on universal high speed machines using the ordinary method requires a great deal of preparatory work (programming). The possibility of constructing a more rational process for a numerical integration of the Laplace equation for a plane-parallel field is examined. (auth)

10160 AEC-tr-3568

DEPENDENCE OF THE LUMINESCENCE YIELD OF PLASTIC SCINTILLATORS WITH TRIPHENYL-PYRAZOLINE ON TEMPERATURE. (Zavisimost' vykhoda liuminesentsentsii plastmassovykh skintillatorov s trifenilpirozolinom ot temperatury.) I. M. Rozman. Translated by Lydia Venters (Argonne National Lab.) from *Optika i Spektroskopiya* 2, 480-7 (1957). 11p. \$3.30(ph), \$2.40(mf) JCL or LC.

French translation available as CEA-tr-R-381.

The dependence of luminescence yield on temperature was examined for plastic scintillators. The luminescence intensities of pure polystyrene and polystyrene with addition of 1,3,5-triphenylpyrazoline were measured at various temperatures. The scintillators were excited by α , β , and γ radiation. A decrease of the temperature dependence in the luminescence yield of polystyrene with an increase of triphenyl polystyrene was found. It was concluded that the decrease is due to the migration of the nonradiative part of the excitation energy from the first substance to the second. (J.R.D.)

10161 AEC-tr-3570

DISTURBANCES IN THE TRANSFER OF EXCITATION ENERGY IN SOLID SOLUTION OF NAPHTHACENE IN ANTHRACENE. (O Narusheniyakh Peredachi Energii Vozbuzhdeniya v Tverdom Rastvore Naftatsena v Antratsene.) A. N. Faidysh, I. Ya. Kucherov, and A. A. Terskii. Translated by Lydia Venters (Argonne National Lab.) from *Optika i Spektroskopiya* 1, 403-6 (1956). 6p. \$1.80(ph), \$1.80(mf) JCL or LC.

The effect of decreasing dimensions of anthracene crystals and the introduction of optically neutral impurities on the reduction of time for energy migration was investigated. Also the effect of decreasing temperature on the efficiency of the energy transfer from the basic substance to the impurity was studied. (auth)

10162 AEC-tr-3581

ESTABLISHMENT OF THE COMPLETE DIAGRAM OF THE SIMULATOR. (Essai d'établissement d'un simulateur électronique pour l'analyse du comportement dynamique d'une chaudière.) René Winand. Translated for Westinghouse Bettis Atomic Power Div., from *Revue de la Société des Ingénieurs*

et des Industriels 5, Chap. 2, 191-220 (1956). 23p. \$4.80(ph), \$2.70(mf) JCL or LC. (Figures illegible).

A method of describing the functioning and interrelations of a system is presented. The case is primarily the behavior of a steam boiler and its regulating mechanism. A detailed scrutiny of the existing variables and magnitudes is presented as well as an analysis of the system. The complete diagram necessitates, on the part of the designer, a knowledge and comprehension of all the physical phenomena that play a part in the system being studied and indicates calculational methods that might be used when it is desirable to replace a group of elements of the simulator by a global element. (J.R.D.)

10163 AERE-Trans-11/3/5/1154

INVESTIGATION OF THE FOCUSING PROPERTIES OF THE ION-EXTRACTION SYSTEM IN A HIGH-FREQUENCY ION SOURCE. A. N. Serbinov. Translated by V. Beak (U.K.A.E.A., Atomic Energy Research Establishment) from *Priory i Tekh. Ekspt.*, No. 3, 39-45 (1958). 14p. (Figures omitted). \$3.30(ph), \$2.40(mf) JCL or LC.

An investigation of a high-frequency ion source ion-extraction system was conducted. The results are the basis for an estimate of the influence of the cathode and insulating cylinder dimensions on ion beam focusing in the cathode channel. Optimum cathode channel dimensions are given, and it is emphasized that the degree of focusing is determined by the ratio of the internal diameter of the insulating cylinder (D) to the channel diameter (d), and by the voltage corresponding to the maximum degree of focusing. The optimum D/d ratio is 1 to 0.6. (J.R.D.)

10164 CEA-tr-A-501

TABLES DE LA PHYSIQUE DES ELECTRONS, DE LA PHYSIQUE DES IONS ET DE LA MICROSCOPIE ELECTRONIQUE. VOLUME I. C. PHYSIQUE DES IONS. II. OPTIQUE IONIQUE. (Tables of Electron Physics, Ion Physics, and Electron Microscopy. Vol. I. C. Ion Physics. II. Ion Optics.) M. Von Ardenne. Translated into French from p.453-75 of Tabellen der Elektronenphysik. Ionenphysik und Übermikroskopie. Band I. Hauptgebiete, Berlin, 1956. 25p.

Data on ion optics are presented in equation, graphic, and tabular form. The characteristics considered are movement of ions under the action of a magnetic field and of a perpendicular electron field, first-order focusing in a radial electrostatic field, the position of the image, importance of the diffusion field in the case of a reproduction with radial electrostatic field, aberration in the case of focusing by a radial electrostatic field, first-order focusing in a homogeneous magnetic field in sector form, dispersion field during image formation with magnetic fields in sector form, aberration errors in focusing by a homogeneous magnetic field in sector form, second-order focusing in a magnetic field, condition of double focusing for mass spectrographs, resolving power of mass spectrographs with double focusing as a function of the slit length, resolving power limited by variations of current sources in double focusing mass spectrographs, magnitude of the mass range for double focusing with different arrangements, magnetic mass separation without focusing and with incomplete focusing of the beam, principle of circular and annular magnetic mass separation with incomplete focusing, mass mag-

netic separation with focusing of parallel beams, and thin ion magnetic lens. (J.S.R.)

10165 CEA-tr-A-502

TABLES DE LA PHYSIQUE DES ELECTRONS, DE LA PHYSIQUE DES IONS ET DE LA MICROSCOPIE ÉLECTRONIQUE. VOLUME I. C. PHYSIQUE DES IONS. III. PRODUCTION D'IONS. (Tables of Electron Physics, Ion Physics, and Electron Microscope. Vol. I. C. Ion Physics. III. Production of Ions.) M. Von Ardenne. Translated into French from p.476-506 of Tabellen der Elektronenphysik. Ionenphysik und Übermikroskopie. Band I. Hauptgebiete, Berlin, 1956. 32p.

Data on ion optics are presented in equation, graphic, and tabular form. The characteristics considered are average thermal velocity of ions, relation between effective cross section of particles for a given process and the total cross section per unit volume, ionization potentials of elements, ionization potentials of molecules, dissociation ionization of molecules by collisions with electrons, differential ionization of gas and vapors by electron beams, ion production by primary electrons of average velocity, degree of ionization and path time of a neutral particle in an electron beam, production of ions with multiple charge, gas ionization by ultraviolet and x rays, thermal ionization in gaseous medium, surface ionization, emission of ions and alkalines from a red-hot Pt anode in a gas containing halogens, thermal vaporization of positive ions, thermal vaporization of negative ions, ionization by electron capture, ion production by ion collisions on metallic surfaces, formation of hydrogen and deuterium ions, the different mechanisms caused by particle collisions. (J.S.R.)

10166 CEA-tr-A-503

TABLES DE LA PHYSIQUE DES ELECTRONS, DE LA PHYSIQUE DES IONS ET DE LA MICROSCOPIE ÉLECTRONIQUE. VOLUME I. C. PHYSIQUE DES IONS. IV. ACCÉLÉRATION D'IONS ET ACTIONS DE LA CHARGE SPATIALE. (Tables of Electron Physics, Ion Physics, and Electron Microscope. Vol. I. C. Ion Physics. IV. Acceleration of Ions and Effects of Space Charge.) M. Von Ardenne. Translated into French from p.507-30 of Tabellen der Elektronenphysik. Ionenphysik und Übermikroskopie. Band I. Hauptgebiete, Berlin, 1956. 27p.

Data on ion acceleration and the effects of space charge are presented in equation, graphic, and tabular form. The characteristics considered are limitation of current density by space charge for plane electrons and ions, limitation of current density by the charge in ion mixtures, enlargement of an ion beam by space charge, potential difference between the edge and the middle of an ion beam because of space charge, axial potential difference caused by space charge, increase of ion radiation by space charge, decrease of the enlargement of radiation caused by space charge in the acceleration energy, density in the ion radiation of a plasma, cause, effect, and attenuation of parasitic currents of negative charge, establishment time for the compensation of the space charge of ion beams, focused ion current with partial compensation of space charge, influence of incomplete compensation of space charge on the passage of beams, and variation of the trajectory of beams by incomplete compensation of the space charge. (J.S.R.)

10167 IGRL-T/CA-86

THEORY OF JOURNAL AIR-BEARING. T. Sasaki and H. Mori. Translated by D. Jackson (U.K.A.E.A., Risley) from *Trans. Soc. Mech. Engrs. (Japan)* 19, No. 6, 45-8(1953).

Theoretical investigations were made concerning the conditions of noneccentric rotation, which is important for inspecting air-bearings because it corresponds to the condition of minimum friction, and a hydrodynamical solution was obtained by considering that the air flow corresponding to the condition of noneccentric rotation is equivalent to the two-dimensional potential flow. Such theoretically obtained results coincide moderately well with the experimental results. The solution can be applied to the case of multiple air-holes. (auth)

10168 IGRL-T/CA-99

A DISCUSSION OF THE APPROXIMATION TO AN IDEAL CASCADE BY MEANS OF A STEPPED CASCADE WITHOUT LOSSES AND ALSO TAKING INTO ACCOUNT LOSS OF MATERIAL. H. Barwich. Translated by B. Rigby (U.K.A.E.A., Capenhurst) from *Ann. Physik* 20, 70-9(1957). 12p.

The efficiency η is used as a measure of the useful separating power of a stage in a real cascade. This is that fraction of the separating power of the stage which is not lost due to mixing. In approximating to an ideal cascade without losses of material by means of a stepped cascade, the minimum mixing loss occurs when η remains the same in passing from one section of plant to the next. The application of this condition leads to a simple method of calculating the structure of the optimum real cascade. This method can only be applied to cascades which suffer losses of material if the loss per unit throughput ω is less than a critical value ω_k , determined from the value function $\Phi(k, c_p)$ for the product and the stage enrichment factor ϵ . However, a method of approximation is given for calculating the structure of cascades where $\omega > \omega_k$. (auth)

10169 NP-tr-191

MATERIALS FOR BIOLOGICAL SHIELDING EXPERIMENTS ON NATIONALLY OBTAINABLE MATERIALS. Emanuele Fumagalli. Translated by R. J. Royston (U.K.A.E.A., Atomic Energy Research Establishment) from Paper No. 207 of the Tenth National Congress of Italian Engineers, Milan, 1957. 12p. \$3.30(ph), \$2.40(mf) JCL or LC.

An exploration of the whole range of densities obtainable with aggregates in cement was conducted with locally procurable materials. The most suitable materials examined included barytes, limonites, magnetites, metallic iron, and ferrophosphorus. Aggregate preparation is described, comparing the various possible mixtures and granule size distributions. Economic aspects are emphasized. Water content is considered, and mixing techniques are examined. Results of experiment are discussed, and it is concluded that very high density concrete can be obtained by use of ferrophosphorus and steel punchings. (J.R.D.)

10170 NP-tr-203

EXCITATION SPECTRUM IN SPARK DISCHARGES. S. L. Mandel'shtam (Mandelstam). Translated for U.K.A.E.A., Atomic Energy Research Establishment from Proceedings of the Sixth International Conference on Spectroscopy at Amsterdam, Pergamon Press, London, 1957, pages 245-251. 10p. \$1.80(ph), \$1.80(mf) JCL or LC.

The excitation processes in spark-channel plasma were investigated. The mechanism of spark-channel formation was shown to be a type of explosion. The spark discharge is characterized by the liberation of a large amount of energy in the first stages. The resulting shock wave removes the gas from the region of the channel leaving a low gas density and high current density plasma. The electron temperature of such plasma is high, the strong ionization causing the hot character of the spark spectrum. The equations for temperature equilibrium at 40,000° can be applied to the spark channel plasma. (J.R.D.)

10171 SCL-T-235

CALCULATION OF THE SUNRISE IN THE IONOSPHERIC LAYERS. (Zur Berechnung des Sonnenaufgangs in den Höhen der Ionosphärenschichten.) H. Kautzleben. Translated by Marcel I. Weinreich (Sandia Corp.) from *Z. Meteorol.* 10, 337-41 (1956). 14p. (Includes original, 5p.) \$3.30(ph), \$2.40(mf) JCL or LC.

A nomogram was developed from which it is possible to derive the true local time of both sunrise and sunset at any desired altitude above any chosen place of observation and for each and every time of year (season). Also, the influence of a screening (shielding) atmospheric stratum in keeping the effective uv radiation away from the earth's surface is considered. (auth)

10172

SOME FURTHER STUDIES ON BETA RAY TRANSMISSION. Erik Odeblad and Erik Ägren. *Acta Radiol.* 51, 128-36 (1959) Feb.

The effect of inhomogeneity on the transmission of beta rays was studied, and a simplified theory is presented. Experimental observations illustrate the theory. The effect of nuclear elastic scattering of the absorbing material is considered, and an approximate method for evaluating the maximum range of beta rays and the exponent of the binomial formula is described. (auth)

10173

CONTRIBUTION TO THE STUDY OF THE ENERGY LOSS OF ELECTRONS PASSING THROUGH THIN METALLIC LAYERS; COMPARISON WITH THE RESULTS OF X-RAY SPECTROSCOPY. Bernard Gauthé. *Ann. phys.* 3, 915-64 (1958) Nov.-Dec. (In French)

An investigation was made to determine a possible correlation between the spectral distribution of the energy loss for electrons passing through metallic films and the position of the absorption structure in the x-radiation spectra of the metals. The electrostatic spectrograph and the sample preparation are described in detail. The methods used in the investigation were copper, silver, gold, nickel, palladium, platinum, beryllium, and germanium. The results obtained are given. The nature of the elementary interactions and the energy losses are discussed. (J.S.R.)

10174

INVESTIGATIONS ON THE ISOTOPIC DISPLACEMENT IN THE ATOMIC SPECTRA OF HEAVY ELEMENTS. Jean Bialse. *Ann. phys.* 3, 1019-76 (1958) Nov.-Dec. (In French)

An investigation was made of the isotopic displacements in the spectra of Cd, Nd, Os, Hg, and Pb. It was determined that the relative positions of isotopes are identical in all the rays measured of a given element. All the spectral terms of the same electronic configura-

tion show analogous isotopic displacements in the absence of perturbation by the terms of other configurations. The effects of such perturbations were studied in detail for mercury and lead. The results obtained permitted an improvement in the classification of the spectra of Pb I, Os I, and Nd I. Precision on the building of the neutron shells between the magic numbers 82 and 126 was obtained. An interpretation of the importance of the phenomenon of "odd-even staggering" was proposed. The investigations confirmed the spin value of $\frac{1}{2}$ for Os¹⁸⁹. (J.S.R.)

10175

STRUCTURE OF SHOCK FRONTS IN IONIZED GASES. Max Krook (Smithsonian Astrophysical Observatory and Harvard Coll. Observatory, Cambridge, Mass.). *Ann. Phys. (N. Y.)* 6, 188-207 (1959) Feb.

A method is given for the solution of the kinetic equations for the structure of a shock wave in an ionized gas. In an approximation of order ν , the kinetic equations are replaced by a set of $(\nu-4)$ equations for moments of the velocity distributions. The procedure is based on a representation of the distribution functions as sums of "modified Maxwell-functions." (auth)

10176

ADIABATIC INVARIANCE TO ALL ORDERS. Andrew Lenard (Princeton Univ., N. J.). *Ann. Phys. (N. Y.)* 6, 261-76 (1959) Mar.

Adiabatic invariance theorems are extended to all orders in the slowness parameter. The concept of adiabatic invariance to all orders is formulated precisely in Section I. In Section II, a classical one-dimensional nonlinear oscillator is treated. It is proved that the action integral extended over a period of the instantaneous time independent problem is an adiabatic invariant to all orders. Section III is devoted to the extension of the Born-Fock quantum mechanical adiabatic theorem to all orders. The systems to which the proof applies in all rigor are those which have a finite number of nondegenerate quantum states which do not cross in the process of adiabatic change. The proofs are based on a systematic construction of the asymptotic expansion in the slowness parameter of the statistical distribution function which describes an initially stationary ensemble of systems. (auth)

10177

EVALUATION OF APPROXIMATE METHODS OF APPLYING BINARY SCALE FACTORS IN PULSE-COUNTING SYSTEMS OF MEASUREMENT. W. T. Bane and M. P. Atkinson (National Physical Lab., Teddington, Middx., Eng.). *Brit. J. Appl. Phys.* 10, 124-31 (1959) Mar.

An approximate system of applying binary scaling factors in pulse-counting systems of measurement is described and the errors involved are evaluated. This system forms the basis of a series of developed systems whose errors are also discussed. The effects producing the errors are not arithmetic, and complete proofs are lacking for some of the expressions, which, however, have been checked over the first part of their range. (auth)

10178

NEW METHOD FOR INCREASING THE X-RAY REFLECTION POWER OF LITHIUM FLUORIDE CRYSTALS. E. F. Priestley (Armament Research and Development Establishment, Fort Halstead, Kent, Eng.). *Brit. J. Appl. Phys.* 10, 141-2 (1959) Mar.

Bending and quenching methods for increasing the dislocation density and hence the x-ray reflection power of lithium fluoride have been found ineffective when applied to certain crystals of British origin. An ultrasonic treatment is described which, with abrasion of the surface, gave a gain in reflection intensity of up to $3\frac{1}{2}$ times at 2.0 Å and 7 times at 0.6 Å. (auth)

10179

EXPERIMENTS ON PROCESSING AND MOUNTING OF NUCLEAR EMULSIONS. B. Judek (National Research Council, Ottawa). *Can. J. Phys.* 37, 102-8(1959) Feb.

A mounting procedure for Ilford G.5, 600 μ stripped emulsions which gave very good results on several large and small stacks, totalling about 10 liters of emulsion, is described. Special tests have shown that emulsions can be developed almost immediately after mounting. Delay of processing for a day or longer after mounting offers no special advantage, while it causes fading of the latent image to an extent of about 15%. Experiments on development with a "warm" stage of 50°F indicate a reduction of spurious scattering to about one-half the value usually obtained with a "warm" stage of about 76°F. At the same time the degree of development obtained was comparable with that at 76°F. A better uniformity of development with depth in the emulsion has been obtained by a variation in the usual development procedure. (auth)

10180

THE K-LL AUGER SPECTRUM OF ^{239}Pu . G. T. Ewan, J. S. Geiger, R. L. Graham, and D. R. MacKenzie (Atomic Energy of Canada, Ltd., Chalk River, Ont., Can.). *Can. J. Phys.* 37, 174-82(1959) Feb.

The K-LL Auger spectrum of ^{239}Pu has been examined using a high-resolution $\pi\sqrt{2}\beta$ -ray spectrometer with a proportional counter detector. Seven lines have been observed in the Auger spectrum with the following energies and relative intensities.

Energy (kev)	75.18	76.05	76.78	80.24	80.40	81.06	85.30
	± 0.015	± 0.015	± 0.04	± 0.015	± 0.06	± 0.015	± 0.015
Relative intensity	1.0	1.86	0.11	0.60	0.05	1.11	0.40
		± 0.10	± 0.04	± 0.06	± 0.03	± 0.07	± 0.05

The presence of seven lines in this K-LL Auger spectrum is in disagreement with theoretical predictions based on pure j-j coupling and supports, rather, the recent theoretical treatment of Asaad and Burhop. The energies of the observed lines are in satisfactory agreement with their theoretical predictions but discrepancies exist in the relative intensities. (auth)

10181

ABSOLUTE STANDARDIZATION OF RADIOACTIVE NEUTRON SOURCES. I. ACTIVATION OF MANGANESE BATH. K. W. Geiger and G. N. Whyte (National Research Council, Ottawa). *Can. J. Phys.* 37, 256-62(1959) Mar.

The neutron emission rate of a Ra- α -Be source of the National Research Council was measured by moderating the neutrons in manganese sulfate solution surrounding the source. Some of the thermal neutrons captured in the bath produce manganese-56, and the neutron emission rate is found from an absolute determination of the resulting activity. A number of corrections are discussed in detail. The value of $(3.22 \pm 0.05) \times 10^6$ neutrons per second found for the neutron emission rate shows satisfactory agreement with the results of intercomparison with the primary

neutron standard of the National Bureau of Standards and allows a tie-in with a series of international comparisons of primary neutron sources. (auth)

10182

SPHERICAL ABERRATION OF MAGNETIC LENSES WITH WEAK CONVERGENCE. Pierre Durandau, Bernard Fagot, and Charles Fert. *Compt. rend.* 248, 946-9(1959) Feb. 16. (In French)

The value of the coefficient of spherical aberration for a series of thin magnetic lenses, symmetric and asymmetric, is given. These values are deduced from the precise measurement of the induction $B(z)$ and of its derivative $B'(z)$ on the axis of actual magnetic lenses. (tr-auth)

10183

THE EFFECT OF NEUTRON IRRADIATION ON THE SPECIFIC HEAT OF GRAPHITE. Bruce Bailey Goodman, Louis Monpetit, and Louis Weil. *Compt. rend.* 248, 956-9(1959) Feb. 16. (In French)

The increase of the specific heat of graphite caused by neutron irradiation was measured between 20 and 80°K for three different doses. For weak doses ($< 10^{19}$ neutrons/cm²) it appears that the increase of the specific heat can be attributed directly to the production of single interstitial atoms. (tr-auth)

10184

EMISSION SPECTRA OF ARGON AND NEON BETWEEN 2 AND 2.5 μ . Georges Hepner. *Compt. rend.* 248, 1142-5(1959) Feb. 23. (In French)

The spectra of argon and neon were studied between 2 and 2.5 μ in a Geissler tube. The rays detected were classified according to the known levels. (tr-auth)

10185

INFRARED ABSORPTION SPECTRUM AT LOW TEMPERATURE OF CRYSTALLIZED DEUTERATED SEIGNETTE SALT (7500-5300 cm⁻¹). Michel-Pierre Bernard. *Compt. rend.* 248, 1153-5(1959) Feb. 23. (In French)

A monocrystal of Seignette salt deuterated to 96% was studied between 7500 and 5300 cm⁻¹ at room temperature or at -180°C. The absorption bands were interpreted by combinations, and the conclusions obtained previously (*Compt. rend.* 242, 1012(1956)) with a nondeuterated crystals of the same salt were confirmed. (tr-auth)

10186

SOME EFFECTS OF NUCLEAR EXPLOSIONS ON THE VERTICAL IONOSPHERIC SOUNDINGS. Dimitri Lepechinsky and Claude Davoust. *Compt. rend.* 248, 1203-6(1959) Feb. 23. (In French)

The anomalies presented by the ionospheric soundings at Tahiti, Maui, and Rarotonga during the nuclear explosions in the Pacific on August 1 and August 12, 1958, were investigated. An auroral manifestation appearing at the time of the first explosion at an ionospheric altitude had an excellent correlation with the exceptional absorption detected, beginning at 11 UT. The existence of such an ionospheric effect of the bomb is explained by the intense heating of the low ionosphere. The explosion of August 12 was experienced by the ionosphere of Maui and Rarotonga beginning at 16 UT although it had taken place at 1030 UT. From the experiences of August 1, 1958, such a displacement of time was not probable. It is therefore assumed that actually the explosion occurred closer to 16 UT. However, the

hypothesis of a slow drift of the radioactive fall-out or a different altitude for the explosion can not be completely ruled out. The "radius of ionospheric influence" of atomic explosions appeared to be approximately 3500 km for the first explosion and 5000 km for the second. (J.S.R.)

10187

MASSES OF Th^{232} , U^{234} , U^{235} AND U^{238} ISOTOPES.

R. A. Demirkhanov, T. I. Gutkin, and V. V. Dorokhov. *Doklady Akad. Nauk S.S.S.R.* **124**, 301-3(1959) Jan. 11. (In Russian)

Masses of Th^{232} , U^{234} , U^{235} , and U^{238} were measured with a spectrometer with a resolving power of 60,000 to 70,000 in the examined mass range. The isotopic mass was estimated by direct comparison with the corresponding mass of organic compounds which contained isotopes H^1 , C^{12} , and N^{14} . In order to form doublets for measuring U^{234} , U^{235} , and U^{238} isotopes, $\text{C}_{20}\text{H}_{12}$, mass 235, was used. Uranium oxide enriched up to ~75% with U^{235} was used for measuring the U^{235} . The doublet was formed with the perylene fragment C_{19}H_7 , mass 235. Uranium oxide enriched with ~1% U^{234} was used for measuring the U^{234} . The isotope was measured with the mass 250 appearing as $\text{U}^{234}\text{O}^{16}$; the perylene fragment $\text{C}_{20}\text{H}_{16}$ with the mass 250 formed the doublet. The Th^{232} mass was measured in the doublet $\text{Th}^{232}-\text{C}_{16}\text{H}_{12}\text{N}_2$. The compatibility control of the values obtained was made by determining the U^{238} mass in the doublets $\text{C}_{18}\text{H}_{10}-\text{U}^{238}$ and $\text{C}_{18}^{12}\text{C}^{13}\text{H}_9-\text{U}^{238}$. The tabulated results show that the U^{238} mass from both doublets coincide within the limits of measurement. The mean value considering the "weight" is $M_{\text{U}^{238}} = 238.127284 \pm 35 \times 10^{-16}$. Correlations of the obtained isotopic mass values with the values calculated from nuclear reactions show smaller values from nuclear reactions. Further measurements made with various hydrocarbon compounds did not differ greatly from the original results. (R.V.J.)

10188

ENHANCED STABILITY OF THE ELECTRIC ARC IN A MAGNETIC FIELD AND THE PRINCIPLE OF FIELD MAXIMUM. I. G. Kesaev (Lenin All-Union Electrotechnical Inst.). *Doklady Akad. Nauk S.S.S.R.* **124**, 563-6(1959) Jan. 21. (In Russian)

The nature of internal instability of a metallic arc and its effects on the behavior of the cathode spot are studied in order to determine the changes in arc stability with internal discharge conditions. Spontaneous arc extinction is the most obvious expression of arc instability and permits the introduction of the arc mean endurance expression \bar{J} as a measure of arc stability. The superposition of longitudinal magnetic field was used as one of the means of acting upon the arc. Such fields have a small effect on the cathode spot motion, thus the field imposed changes are simple and are expressed by distortions of electron trajectories and by diminished diffusion cross sections. A similar effect can be obtained by adding inert gases with sufficiently high ionization potential. The apparatus and methods of measuring \bar{J} are described, and the arc mean life spans are plotted. The data show that the scattering of charges and related cathode-spot energies are one of the primary causes of arc instability. The magnetic field considerably cuts down on these losses, stabilizing the action. (R.V.J.)

10189

THEORY OF THE ELECTRIC DISCHARGE IN A MOVING CONDUCTING MEDIUM. V. N. Zhigulev

(Zhukovskii Central Aerohydrodynamic Inst.). *Doklady Akad. Nauk S.S.S.R.* **124**, 1226-8(1959) Feb. 21. (In Russian)

A new phenomenon of electric discharge pinch in moving conducting media which can be used for obtaining high temperatures was studied. (R.V.J.)

10190

PHOTOGRAPHIC EMULSIONS IN NUCLEAR PHYSICS.

Erno Bujdóso. *Energia és Atomtech.* **11**, 312-17(1959) Apr.-May. (In Hungarian)

The properties and applications are described of special emulsions with high silver bromide content (up to 85%) and a very small average particle size (0.1 to 0.4 μ). The latent image of these emulsions is formed by charged particles rather than by light. (R.V.J.)

10191

ELECTRODYNAMIC CONTAINMENT OF CHARGED PARTICLES. R. F. Wuerker, H. Shelton, and R. V. Langmuir (Ramo-Wooldridge Research Lab., Los Angeles). *J. Appl. Phys.* **30**, 342-9(1959) Mar.

Electrically charged iron and aluminum particles having diameters of a few microns were contained in a confined region of space by means of alternating and static electric fields. The theory is essentially that of alternating gradient focusing; here the motion is governed by Mathieu's equation. Under certain circumstances when many particles are confined the three-dimensional focusing force and the Coulomb repulsion result in a "crystalline" array which can be "melted" and re-formed. (auth)

10192

ELECTRODYNAMIC CONTAINMENT OF CHARGED PARTICLES BY THREE PHASE VOLTAGES. R. F. Wuerker, H. M. Goldenberg, and R. V. Langmuir

(Thompson Ramo-Wooldridge, Inc., Los Angeles). *J. Appl. Phys.* **30**, 441-2(1959) Mar.

The containment of charged particles within an axially symmetric electrode structure by alternating electric fields has recently been described (*J. Appl. Phys.* **30**, 342(1959)). This system has the inherent geometrical property that the average focusing force along the axis of symmetry is twice as great as the average restoring force in the equatorial plane. A configuration is discussed which produces cubic symmetry by the application of three-phase voltages rather than the axial symmetry obtained with single-phase excitation. This arrangement offers advantages in simplicity of construction, optical illumination and observation, irradiation of contained dust particles by electron and ion beams, mass injection, and the application of auxiliary fields. (A.C.)

10193

VARIATION OF VALENCE STATE OF Eu IN SrS

PHOSPHORS. Seymour P. Keller (IBM, Poughkeepsie, N. Y.). *J. Chem. Phys.* **30**, 556-60(1959) Feb.

Phosphors containing SrS as the base material and 0.04% Eu as the activator were prepared in various reducing or oxidizing atmospheres. Firings in reducing atmospheres produced divalent Eu and firings in oxidizing atmospheres produced decreasing amounts of divalent Eu and increasing amounts of trivalent Eu depending on the degree of oxidizing character of the atmosphere. The relative amounts of the two valence states were determined by observing the fluorescent emission and by measuring the paramagnetic resonance absorption of the samples. (auth)

10194

EFFECT OF PARAMAGNETIC IONS ON THE NUCLEAR MAGNETIC RESONANCE OF O^{17} IN WATER AND THE RATE OF ELIMINATION OF WATER MOLECULES FROM THE FIRST COORDINATION SPHERE OF CATIONS. Robert E. Connick and Richard E. Poulson (Univ. of California, Berkeley). *J. Chem. Phys.* **30**, 759-61(1959) Mar.

Observations have been made on the relative effectiveness of various paramagnetic ions in broadening the nuclear magnetic resonance of O^{17} in water and it is inferred that the relaxation occurs almost entirely in the first coordination sphere of all of the cations studied except chromic ion. Accepting this hypothesis, it is possible to calculate lower limits for the rates of exchange of bulk water molecules with those in the first coordination sphere of the cations. For ferric ion the lifetime of a coordinated water molecule is equal to or less than 10^{-8} second at room temperature. (auth)

10195

MASS SPECTRUM OF ACETYLENE PRODUCED BY 5.1-Mev ALPHA PARTICLES. C. E. Melton and P. S. Rudolph (Oak Ridge National Lab., Tenn.). *J. Chem. Phys.* **30**, 847-8(1959) Mar.

The mass spectrum of acetylene produced by 5.1-Mev alpha particles was measured and compared with that produced by 75-ev electrons. Striking differences were noted, and it is indicated that alpha-induced ionization may be useful in mass spectral analysis as well as in radiation chemistry. (T.R.H.)

10196

ASSOCIATED DONOR-ACCEPTOR LUMINESCENT CENTERS IN ZINC SULFIDE PHOSPHORS. E. F. Apple and F. E. Williams (General Electric Co., Schenectady, N. Y.). *J. Electrochem. Soc.* **106**, 224-30(1959) Mar.

Zinc sulfide activated with copper or silver and co-activated with gallium or indium shows two emission bands. The shorter wave-length band does not involve the ground state of the coactivator or donor, whereas the longer wave-length band does. Both bands involve the ground state of the activator or acceptor. The factors contributing to the emission intensities from the various associated donor-acceptor pairs are discussed theoretically. The dependences on temperature and on concentrations of activator and coactivator are in accord with the longer wave-length band involving a highly associated donor-acceptor pair. In addition, the energy levels of the donors, as obtained from thermoluminescent data, are correlated on the basis of the model with the differences in the transition energies of the two emission bands of these phosphors. (auth)

10197

ARCTIC MEASUREMENT OF ELECTRON COLLISION FREQUENCIES IN THE D-REGION OF THE IONOSPHERE. J. A. Kane (U. S. Naval Research Lab., Washington, D.C.). *J. Geophys. Research* **64**, 133-9 (1959) Feb.

Electron collision frequencies in the D-region were measured with the aid of rockets launched during polar blackouts at Fort Churchill, Canada (58° N). During the blackouts the ionization content of the D-region was large enough to cause a strong altitude-dependent absorption of a 7.75 Mc/s CW signal, radiated from the rocket. The refractive indices and the difference absorption of the two magneto-ionic components of this

signal were simultaneously measured versus altitude. The electron collision frequency profile was then determined from these measurements. The results from two midday rocket flights, one made in July 1957 and the other in November 1956 indicate that the electron collision frequencies in the Arctic D-region are lower by a factor of three than the standard values calculated. At 70 km the measured value of the collision frequency is $(1.0 \pm 0.3) \times 10^7 \text{ sec}^{-1}$. (auth)

10198

SOME OBSERVATIONS OF LOW-LEVEL ION CLOUDS. Charles J. Brasefield (Southern Illinois Univ., Carbondale). *J. Geophys. Research* **64**, 141-8(1959) Feb.

Simultaneous measurements have been made of the atmospheric potential at 33 meters, 21 meters, and 8 meters above ground level, using three radioactive probes. The current from each probe to ground passed through a number of 100,000 megohm resistors and the i-r drop across a terminal resistor of 400 megohms was measured. These measurements indicate that clouds of ions whose net charge was sometimes positive and sometimes negative frequently passed overhead at altitudes of ten meters and less. The origin of the ion clouds is uncertain, but it appears that some, if not all, were produced by motor vehicles, particularly diesel-powered vehicles. (auth)

10199

PROGRESS IN COSMIC RAY RESEARCH SINCE 1947. B. Peters (Tata Inst. of Fundamental Research, Bombay and University Inst. of Theoretical Physics, Copenhagen). *J. Geophys. Research* **64**, 155-73(1959) Feb.

Cosmic ray physics, which ten years ago was a fairly specialized branch of science, has in the course of its recent development become closely linked with many other fields of research. It has become an integral part of astrophysics, radioastronomy, and solar physics; it has made important contributions to such diverse fields as geomagnetism, hydrology, and archeology, and has begun to gain some importance in the study of meteorites and of oceanography and meteorology. It has also given rise to one of the newest and most active branches of physics, 'particle physics,' and has thereby provided the impetus for designing the large and powerful particle accelerators which are now in operation or under construction in various parts of the world. This paper is a survey of the most important developments which have taken place in cosmic ray physics during the last decade. The principal technical advances which have exerted decisive influence on cosmic ray research are the development of large stratosphere balloons, of nuclear emulsions, and of radio telescopes, as well as the great progress made since the war in radio chemistry and in low level beta- and gamma-ray counting. The three sections following the introduction discuss how, with the help of these and other techniques, the nature of the primary cosmic ray particles was determined and how a connection was established between cosmic ray effects and astrophysical and solar phenomena. The next section deals with largely successful efforts which have been made to understand the complicated chain of processes by which the energy carried by primary cosmic ray particles entering from outer space is first distributed over a great variety of new stable and unstable particles and finally is dissipated within the atmosphere. The two following sections treat the discovery of stable and radioactive

isotopes which are produced during the passage of cosmic radiation through the atmosphere and contain a short review of the application which these isotopes have found in other branches of science. The last section contains a brief discussion of still unsolved problems which have now become accessible because of more recent technical advances such as satellites, permanent polar stations, and synoptic cosmic ray observations during the International Geophysical Year. (auth)

10200

EXCESS RADIATION AT THE PFOTZER MAXIMUM DURING GEOPHYSICAL DISTURBANCES. Robert R. Brown (Univ. of California, Berkeley). *J. Geophys. Research* **64**, 323-9(1959) Mar.

Observations of the counting rate of a single Geiger counter at the Pfofzer maximum (~ 50 gm/cm² atmospheric depth), when compared with nucleonic intensity data obtained with a sea-level neutron monitor, indicate the temporary presence of radiation in excess of normal cosmic radiation during geophysical disturbances at a latitude well below the auroral zone. In the absence of such disturbances, the total intensity variations at the intensity maximum were found to be 2.2 times larger than variations of the nucleonic intensity at sea level. (auth)

10201

MEASUREMENT OF THE ANGULAR DISTRIBUTION OF THE SCATTERING WITH CHARGE EXCHANGE BY ARGON ATOMS WITH POSITIVE IONS OF ARGON-40, PALLADIUM-108, AND URANIUM-238 WITH ENERGY EQUAL TO 30 kev. C. Cassagnol, F. Daniel, G. Delmas, and G. Ranc (C.E.N., Saclay, France). *J. phys. radium* **20**, 20-4(1959) Jan. (In French)

A description is given of the method used and of the experimental arrangement and procedures. The results are graphed. (auth)

10202

THE DISTRIBUTION OF LATENT IMAGES CAUSED BY β RAYS OF DIFFERENT ENERGIES ON THE SURFACE AND IN THE INTERIOR OF THE GRAINS OF SILVER HALIDES IN NUCLEAR PLATES. Shinichi Kikuchi (Collège de France, Paris). *J. phys. radium* **20**, 62-4(1959) Jan. (In French)

The effects of beta rays of energy from 50 to 500 kev on the distribution of latent images in the grains of nuclear emulsions were studied using a beta spectrometer. The experimental arrangement and procedures are described. The results showed that beta rays give surface and internal latent images in the grains of silver halides. The ratio of the intensities of the two images are not very different in this energy range from that obtained with light. The surface images were more dense than the internal latent images under all experimental conditions. (J.S.R.)

10203

ENERGY-ANGLE DISTRIBUTION OF BREMSSTRAHLUNG SPECTRUM. M. Vakselj and N. Bezič. "J. Stefan" *Inst. Repts.* (Ljubljana) **5**, 9-11(1958) Oct.

The differential bremsstrahlung cross section of Bethe and Heitler is integrated over scattered electron angles to obtain energy-angle distribution of bremsstrahlung spectrum. The integration was carried out exactly by an analytic approximation for the Hartree field of the atom, giving a better approximation than the Thomas-Fermi field, especially for low values of q . (auth)

10204

NEUTRON AGE OF AQUEOUS SOLUTIONS OF URANYL FLUORIDE. M. Copič. "J. Stefan" *Inst. Repts.* (Ljubljana) **5**, 13-19(1958) Oct.

Using two-group neutron diffusion theory, the neutron age of solutions of uranyl fluoride in ordinary water is calculated from the critical data of the spherical assemblies completely reflected by ordinary water. The reduced neutron age of solutions is given in dependence on the concentration of UO_2F_2 . The extrapolated value to zero concentration gives for the reduced neutron age of pure water the value 30.45 g²/cm⁴. (auth)

10205

MASS SPECTROMETRIC MEASUREMENTS OF UF_6 . L. Debevec, V. Kramer, J. Marsel, and V. Vrščaj. "J. Stefan" *Inst. Repts.* (Ljubljana) **5**, 33-9(1958) Oct.

At small differences in isotopic composition of two samples a very high reproducibility of the working conditions of the mass spectrometer is absolutely necessary. This can be achieved by alternating introduction of the samples being compared. The possibility of isotope fractionation in the gas inlet system and the influence of the "memory effect" on successive measurements was investigated. The isotope ratio 238/235 of natural uranium was determined as 138.2 ± 0.4 . (auth)

10206

BREMSSTRAHLUNG CROSS SECTION AT THE SHORT-WAVE LIMIT. M. V. Mihailović. "J. Stefan" *Inst. Repts.* (Ljubljana) **5**, 137-44(1958) Oct.

The differential cross section per unit energy interval of the photon at the high-energy end is calculated using Sommerfeld-Maue's functions for both ingoing and outgoing electrons. An estimate of error shows that the result is expected to be satisfactory for $Z \leq 42$. (auth)

10207

NEW METHOD OF INDIVIDUAL DOSIMETRY.

R. Paoletti (Univ. of Milan). *Minerva nucleare* **2**, 393-4(1958) Dec. (In Italian)

If sensitized by infrared radiation, $SrS(Eu, Sm)$ crystals are luminescent after exposure to ionizing radiation. The use of this luminescence for individual dosimetry is discussed. (J.S.R.)

10208

COSMIC DUST IN THE ATMOSPHERE. D. W. Parkin and W. Hunter (Liverpool Coll. of Tech.). *Nature* **183**, 732-4(1959) Mar. 14.

In an attempt to detect fine dust from the Perseid meteor shower, magnetic particles were collected during August 1957 and 1958 by observers in Great Britain and Greenland. Many of these particles were collected directly from the air by greased slides attached to aircraft and by placing bowls of filtered water in isolated places. However, a vast number appeared in chimney ash, and some doubt exists concerning their origin. The majority of these particles were black or silvery in color and averaged about 50μ in diameter. Examinations indicate that many of them were metallic iron with traces of copper. The strongest argument in favor of an extraterrestrial origin was the detection of nickel in particles that were collected during August 1958 at the south-west tip of St. Agnes, Isles of Scilly. (J.H.M.)

10209

ON THE THEORY OF DISPERSION RELATIONS FOR PHOTON NUCLEON SCATTERING. A. A. Logunov and

P. S. Isaev (Joint Inst. for Nuclear Research, Moscow). Nuovo cimento (10) 10, 917-42(1958) Dec. 16.

An exact proof of dispersion relations for Compton scattering on nucleons is given. The derivation is obtained following a method suggested by Bogoljubov; only strong interactions are taken into account. (auth)

10210

DIFFUSION OF ^{214}Pb IN NUCLEAR EMULSIONS.

E. Frota Pessoa and N. Margem (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nuovo cimento (10) 10, 1039-48(1958) Dec. 16.

A study is made of the diffusion in nuclear emulsions of Pb^{214} and Bi^{214} . It is shown that the diffusing nuclide is Pb^{214} although a small diffusion of Bi^{214} is not excluded. The order of magnitude of the coefficient of diffusion of Pb^{214} is found to be 10^{-12} cgs. The percentage of non diffusing Pb^{214} atoms is found to be of the order of 50% in the examined plates. (auth)

10211

GAUGE-INVARIANT QUANTUM ELECTRODYNAMICS.

Irwin Goldberg (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 112, 1361-6(1958) Nov. 15.

Electrodynamics is quantized without resort to subsidiary conditions. The quantization is carried out by identifying quantum commutators with the commutators of a classical transformation group related to the canonical transformations. The resulting theory is completely gauge invariant, and Maxwell's equations hold as operator equations. The quantization of both electromagnetic and electron fields is carried out in terms of gauge-invariant quantities. For the Dirac field the observables satisfy commutation relations. The anti-commutation rules satisfied by the field variables must be deduced from the commutators of observables. The resulting theory is completely equivalent to the usual quantum electrodynamics. (auth)

10212

CORRELATION OF ANNIHILATION RADIATION IN ORIENTED SINGLE METAL CRYSTALS.

Stephan Berko and John S. Plaskett (Univ. of Virginia, Charlottesville). Phys. Rev. 112, 1877-87(1958) Dec. 15.

Precision measurements of the two-photon annihilation in crystals of Al and Cu are presented. These show relatively small variation with crystal orientation. This is interpreted to mean that the strong high-momentum tail in the Cu distribution is due to annihilation with the 3d electrons and that the Fermi surface in Al is very nearly spherical but has slight bulges in the [100] and [111] directions. One-electron calculations of the distributions for Cu and Al agree quite well with the experiments and further confirm the importance of core annihilation in Cu. The calculated positron lifetime in Cu does not disagree with previous experimental observations by more than a factor of two. Electron-positron correlation by any factor much larger than this is therefore precluded. (auth)

10213

CRITICAL FIELD MEASUREMENTS ON SUPERCONDUCTING LEAD ISOTOPES.

D. L. Decker, D. E. Mapother, and R. W. Shaw (Univ. of Illinois, Urbana). Phys. Rev. 112, 1888-98(1958) Dec. 15.

The measurement of the isotope effect upon the superconducting critical field of lead was extended from T_c to 1.28°K, and an accurate critical-field curve for lead is reported for this temperature range. The

measured critical-field curve is expanded as a function of T^2 and used in calculating the thermodynamic properties of lead. The values for the coefficient of the electronic specific heat in the normal state and for the latent heat of the superconducting transition are in good agreement with calorimetric measurements. The electronic specific heat in the superconducting state does not show an exponential $1/T$ dependence but instead a close resemblance to a T^4 dependence below 5°K. The temperature dependence of the critical field of lead, like that of most superconductors, is not parabolic. However, the observed H_c values lie above a parabola passing through H_0 and T_c which is in the opposite direction from the deviations shown by all other superconductors for which precise data are available. It is shown that an empirical correlation exists for superconductors between the deviation from parabolic behavior and T_c/θ_0 , where θ_0 is the Debye temperature at $T = 0^\circ\text{K}$. Measurements of the isotope effect upon the critical field below T_c show small differences in the coefficient of the normal electronic specific heat, γ , between specimens but in general give support to the principle of similarity in lead to about the same precision as has been reported for other superconductors. (auth)

10214

QUENCHING OF POSITRONIUM LIFETIMES BY MOLECULAR IODINE.

C. R. Hatcher and W. E. Millett (Univ. of Texas, Austin). Phys. Rev. 112, 1924-6(1958) Dec. 15.

Measurements of the mean life of the τ_2 component for decay in solutions of iodine in normal heptane give a value of 10^{-17} cm² for the cross section of molecular iodine for annihilating ^{32}S positronium on collision. This effect is attributed to an enhancement of "pickoff" annihilation resulting from either a tendency to form positronium iodide or the high polarizability of molecular iodine. In quenching τ_2 from 2.49×10^{-8} sec to 1.32×10^{-8} sec the intensity I_2 of the long component was observed to vary over a range from 40% to 27%; however, the errors in I_2 are so large for the shorter lifetimes that it is impossible to tell from the data whether or not I_2 is influenced by the presence of iodine. (auth)

10215

ELASTIC SCATTERING OF C^{12} FROM GOLD.

E. Goldberg and H. L. Reynolds (Univ. of California, Livermore). Phys. Rev. 112, 1981-8(1958) Dec. 15.

The angular distribution of C^{12} ions elastically scattered by gold was measured at the following laboratory energies: 118 ± 2 , 101 ± 2 , 79.4 ± 3 , and 73.6 ± 3 Mev. Heavy ions from the Berkeley heavy-ion linear accelerator (HILAC) were recorded in two Ilford E-1 plates from a scattering angle of 19° to 159° . In all cases the differential cross sections exhibited a Coulomb-like behavior at small angles, a rise above Coulomb of about 20% as the scattering angle increased, and then a rapid drop below Coulomb in much the same manner as alpha particles scattered from heavy elements in the 20 to 40 Mev range. The Blair "sharp cutoff" model reproduces closely the character of the data; however, small oscillations predicted from the model are not experimentally observed. Interaction distances of $(11.8 \pm 0.3, 12.1 \pm 0.3, 11.85 \pm 0.4, \text{ and } 11.85 \pm 0.45) \times 10^{-13}$ cm, respectively, for the foregoing energies are inferred from application of the Blair model. (auth)

10216

DISPERSION RELATION FOR NONRELATIVISTIC POTENTIAL SCATTERING. Benjamin W. Lee (Univ. of Pittsburgh). *Phys. Rev.* **112**, 2122-4 (1958) Dec. 15.

A new dispersion relation for nonrelativistic potential scattering, when the potential has a finite extent, is derived by completing the contour of integration along a semicircle of infinite radius in the lower half of the complex λ plane ($\text{Re } \lambda = k$). The residue terms then explicitly exhibit the contributions from virtual states and radioactive decaying states. Resemblance between the residue term arising from a radioactive decaying state and the Breit-Wigner resonance formula is noted and the Breit-Wigner formula is shown to follow correctly from the analytic properties of the S matrix. (auth)

10217

LATTICE VIBRATIONS IN GERMANIUM BY SCATTERING OF COLD NEUTRONS. A. Ghose, H. Palevsky, D. J. Hughes, I. Pelah, and C. M. Eisenhauer (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **113**, 49-52 (1959) Jan. 1.

The dispersion relations for the optical and acoustical vibrations in the [100] and [110] directions in germanium were determined by means of cold-neutron scattering measurements. An improved experimental method provided data with smaller experimental error. The theoretical interpretation of the results indicates a long-range force between germanium atoms. (auth)

10210

COMPTON SCATTERING OF X-RAYS FROM NON-SPHERICAL CHARGE DISTRIBUTIONS. A. J. Freeman (Ordnance Materials Research Office, Watertown, Mass. and Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* **113**, 169-75 (1959) Jan. 1.

The Waller-Hartree theory for the incoherent Compton scattering of x rays is extended to include the effects of the inherent nonsphericity of atomic charge distributions. The dependence of the scattering on atomic orientation is treated by a general formalism which depends on the use of the matrix elements of a unitary representation of the group of three-dimensional rotations. Application is made to derive the one-electron scattering matrix elements from atoms with s, p, and d electrons. It is shown that by a proper averaging over all orientations of the scattering vector, "mean" scattering formulas result which may be used directly for predicting the scattering from monatomic gases. (auth)

10219

COMPTON SCATTERING OF X-RAYS FROM ALUMINUM. A. J. Freeman (Ordnance Materials Research Office, Watertown, Mass. and Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* **113**, 176-8 (1959) Jan. 1.

Hartree-Fock self-consistent field wave functions were determined for the aluminum atom and used to calculate the x-ray Compton scattering for aluminum according to the Waller-Hartree theory as extended in a previous paper. The predictions of this theory are compared with experiment and previous theoretical calculations. The theoretical results are in very good agreement with the measurements of Walker but differ from those of Laval at low $\sin \theta / \lambda$. (auth)

10220

TOTAL CROSS SECTIONS FOR MULTIPLE ELECTRON STRIPPING IN ATOMIC COLLISIONS AT ENERGIES

TO 100 kev. P. R. Jones, F. P. Ziemba, H. A. Moses, and E. Everhart (Univ. of Connecticut, Storrs). *Phys. Rev.* **113**, 182-91 (1959) Jan. 1.

Total cross sections were measured for electron capture and stripping of He^+ , Ne^+ , and Ar^+ ions in single collisions of He^+ on He, Ne, and Ar, Ne^+ on Ne and Ar and Ar^+ on Ar. Where He^+ ions are incident, the cross sections are given for electron capture, σ_{10} ; for electron loss, σ_{12} ; and for "elastic" scattering in excess of one degree, $\sigma_{11} > 1^\circ$. Where Ne^+ and Ar^+ are incident, the cross sections for multiple stripping $\sigma_{13}, \dots, \sigma_{17}$ are given also. The measurements were made at 25, 50, and 100 kev and at additional energies in two cases where a maximum in the electron capture cross section was observed. Each total cross section was compiled by adding the contributions from the various angular regions into which the incident particle may be scattered. The contribution from the particles scattered between 0° and 1° was measured directly, while that for regions in excess of 1° was obtained by integrating the measured differential cross sections. In the region between 1° and 4° the differential cross section for each process was measured with high resolution and these data are presented separately. These differential measurements supplement data previously published for angles in excess of 4° . Tables are presented showing the contribution of each of the angular regions to the various total cross sections. Large-angle scattering is found to make a significant contribution to the total cross sections for the production of the more highly ionized particles. (auth)

10221

SCATTERING OF CHARGED PARTICLES BY NEUTRAL ATOMS. Marvin H. Mittleman (Univ. of California, Livermore) and Kenneth M. Watson (Univ. of California, Berkeley). *Phys. Rev.* **113**, 198-211 (1959) Jan. 1.

A new technique is described for calculation of the scattering of charged particles by atoms. This is done by means of an expansion in "incoherent fluctuations" of the state of the atom. Two limiting cases are discussed—the adiabatic and the high-energy limits. The structure and convergence of the expansion are investigated. Several variational techniques may be used within the framework of the method described. Finally, a detailed study is made of scattering by hydrogen atoms. (auth)

10222

GENERAL RELATION BETWEEN FLUXES FROM COLLIMATED POINT AND PLANE SOURCES OF RADIATION. Martin J. Berger and Lewis V. Spencer (National Bureau of Standards, Washington). *Phys. Rev.* **113**, 408-12 (1959) Jan. 15.

The radiation density from a collimated point source is shown to be representable as a Fourier-Hankel transform of the density from a collimated plane oblique source. The spatial moments of a point-source density are similarly expressible as linear combinations of a finite number of moments of plane-source densities corresponding to different source obliquities. These results are valid for any type of radiation, provided that the medium is unbounded, homogeneous, and isotropic, and provided that a linear transport equation applies. The plane-geometry representation of densities and density-moments is equivalent to a "separation of variables." It allows one to solve a sequence of problems in one space variable for different values of the

source obliquity, and to use the information thus obtained for constructing the solution of a problem involving two space variables. (auth)

10223

SOUND VELOCITY AND ADIABATIC COMPRESSIBILITY OF LIQUID HELIUM THREE. Henry L. Laquer, Stephen G. Sydorak, and Thomas R. Roberts (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* **113**, 417-22(1959) Jan. 15.

The velocity of first sound at 5 Mc/sec was measured in liquid He^3 between 0.34 and 3.14°K. The results are fitted within 0.2% by the equation $u = 183.9 - 5.98T^2 - 0.130T^3 - 0.00176T^4$ (m/sec). Initial pressure coefficients of the sound velocities and a number of derived thermodynamic quantities are also reported. (auth)

10224

EFFECT OF PRESSURE ON ANELASTIC RELAXATION IN SILVER-ZINC. G. W. Tichelaar and D. Lazarus (Univ. of Illinois, Urbana). *Phys. Rev.* **113**, 438-44 (1959) Jan. 15.

Using a novel experimental apparatus, studies were made of the effect of hydrostatic pressure up to 9000 kg/cm² on the rate of stress relaxation at constant small strain in an Ag-30 atomic percent Zn alloy, where the relaxation process is presumably diffusion limited. For temperatures between 110 and 150°C the relaxation time is found to increase exponentially with pressure. The zero-pressure data are in good agreement with previous work by Nowick. At 9000 kg/cm² the relaxation time is about a factor of four greater than at 1 kg/cm², for all temperatures. The pressure dependence can be interpreted in terms of an "activation volume" of 5.36 ± 0.07 cm³/mole, which is about half the atomic volume of the material. This may mean that the volume of formation of a vacancy is at most about half of the molar volume, which number is in accordance with a recent calculation by Tewordt. (auth)

10225

NEUTRON DIFFRACTION INVESTIGATIONS OF THE MAGNETIC ORDERING IN FeBr_2 , CoBr_2 , FeCl_2 , AND CoCl_2 . M. K. Wilkinson, J. W. Cable, E. O. Wollan, and W. C. Koehler (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **113**, 497-507(1959) Jan. 15.

Neutron diffraction experiments were performed on anhydrous FeBr_2 , CoBr_2 , FeCl_2 , and CoCl_2 at temperatures from 295 to 4.2°K to investigate the existence of magnetic ordering in these hexagonal layer-type structures. All four compounds have an antiferromagnetic transition at low temperatures to structures in which the atomic magnetic moments within a metal layer form ferromagnetic sheets and the moments in adjacent layers are antiparallel. In the iron compounds the moments are oriented parallel to the hexagonal *c* axis and in the cobalt compounds the moment orientation is perpendicular to that axis. Values of the atomic magnetic moments are close to those expected for the divalent metallic ions if the orbital contribution is quenched. Small-angle scattering experiments on FeCl_2 and CoCl_2 have shown that the ferromagnetic coupling between moments within a layer is much stronger than the antiferromagnetic coupling between atoms in adjacent layers, and single-crystal investigations on these two compounds have determined the method by which large net magnetization values are obtained at temperatures below T_N in moderate magnetic fields. (auth)

10226

RADIATION DAMPING IN NUCLEAR MAGNETIC RESONANCE. A. Szöke and S. Meiboom (Weizmann Inst. of Science, Rehovot, Israel). *Phys. Rev.* **113**, 585-6(1959) Jan. 15.

The effect of radiation damping on nuclear magnetic resonance spectra was demonstrated experimentally. Observations on a nuclear two-level maser, obtained by flipping the magnetization through about 180 degrees, are reported. (auth)

10227

SPACINGS OF NUCLEAR ENERGY LEVELS. Lawrence Dresner (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **113**, 633-5(1959) Jan. 15.

A simple statistical model is suggested in terms of which the general features of the level spacing distribution can be understood, and which involves no special assumptions, other than that of Porter and Thomas. (auth)

10228

COSMIC-RAY INCREASES ASSOCIATED WITH SOLAR FLARES. L. C. Towle and J. A. Lockwood (Univ. of New Hampshire, Durham). *Phys. Rev.* **113**, 641-7(1959) Jan. 15.

Data from a standard IGY neutron monitor located on Mount Washington, New Hampshire, were examined for possible increases associated with solar flares. The 0400 and 0900 impact zones were located for both the standard centered dipole and the westward rotated centered dipole approximations. No increases $\geq 0.25\%$ were found for the years 1956 and 1957. An additional maximum in the mean daily cycle at the time of impact zone passage was not observed during this period. Possible explanations for this result are presented. (auth)

10229

HIGH-ENERGY ELECTRON SCATTERING AND THE CHARGE DISTRIBUTION OF CARBON-12 AND OXYGEN-16. Hans F. Ehrenberg, Robert Hofstadter, Ulrich Meyer-Berkhout, D. G. Ravenhall, and Stanley E. Sobottka (Stanford Univ., Calif.). *Phys. Rev.* **113**, 666-74(1959) Jan. 15.

The scattering of high-energy electrons from C^{12} reported previously, was extended to 420 Mev. The elastic and inelastic scattering from the first excited level at 4.43 Mev was studied between 33 and 70°. The new data are in good agreement with what one would expect from the earlier measurements on C^{12} performed at 187 Mev. Additional measurements of the elastic O^{16} -scattering cross sections of 240-, 360-, and 420-Mev electrons as functions of the scattering angle furnish information on the size and shape of the O^{16} nucleus. Pronounced diffraction minima in the angular distributions were observed for C^{12} and O^{16} . The experimental results are compared with the predictions of a theoretical phase-shift analysis derived for the harmonic-well independent-particle model of the nucleus. Preliminary best fits confirm the shell-model predictions for the charge density distribution of these p-shell nuclei. The preliminary analysis of the data shows that the length parameter of the well is 1.66×10^{-13} cm for C^{12} , and 1.76×10^{-13} cm for O^{16} , thus indicating a slight variation of the curvature of the harmonic well as the p shell is filled in. (auth)

10230

FURTHER EVIDENCE FOR A VARIATION IN THE RATE OF DENSE EXTENSIVE AIR SHOWERS WITH

SOLAR TIME. C. B. A. McCusker, D. E. Page, and R. A. Reid (Dublin Inst. for Advanced Studies). Phys. Rev. **113**, 712-13(1959) Jan. 15.

The variation in the rate of dense extensive air showers with solar time previously found in Dublin, Ireland was confirmed using a similar apparatus situated in Mona, Jamaica. It is suggested that this and other variations in rate with solar time may possibly be due to a periodic change in the structure function of the showers. (auth)

10231

THE ISOTHERMS OF THE HYDROGEN ISOTOPES AND THEIR MIXTURES WITH HELIUM AT THE BOILING POINT OF HYDROGEN. J. J. M. Beenakker, F. H. Varkamp, and A. van Isterbeek (Kamerlingh Onnes Laboratorium, Leiden). Physica **25**, 9-24(1959) Jan.

The second virial coefficients of H_2 , HD, and D_2 and their mixtures with helium were determined at the boiling point of hydrogen. The accuracy of the method is of the order of 10^{-4} amagat. Control measurements were performed on He, giving good agreement with Keesom's adopted values. The results for H_2 deviate about 7% from the data of Van Agh and Kamerlingh Onnes. (auth)

10232

COMPRESSIBILITY ISOTHERMS OF HYDROGEN AND DEUTERIUM AT TEMPERATURES BETWEEN -175°C AND $+150^\circ\text{C}$ (AT DENSITIES UP TO 960 AMAGAT).

A. Michels, W. de Graaff, T. Wassenaar, J. M. H. Levelt, and P. Louwerse (Gemeente Universiteit, Amsterdam). Physica **25**, 25-42(1959) Jan.

Compressibility isotherms of hydrogen and deuterium are given in the following ranges of temperatures, densities, and pressures: hydrogen at temperatures from -175 to -25°C and at densities up to 640 Amagat (maximum pressure about 1000 atmospheres); at temperatures from 0 to 150°C and at densities up to 960 Amagat (maximum pressure about 2950 atmospheres); deuterium at temperatures from -175 to -25°C and at densities up to 610 Amagat (maximum pressure about 900 atmospheres); at temperatures from 0 to 150°C and at densities up to 950 Amagat (maximum pressure about 2800 atmospheres). (auth)

10233

AN ARC MAINTAINED ON AN ISOLATED METAL PLATE EXPOSED TO A PLASMA. A. E. Robson and P. C. Thonemann (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London) **73**, 508-12(1959) Mar.

It is shown theoretically that a cathode spot may be maintained on an isolated metal surface immersed in the plasma of a gas discharge. Two experiments are described in which arcs of this kind were produced on a mercury surface. (auth)

10234

AUGER EFFECT IN SEMICONDUCTORS. A. R. Beattie and P. T. Landsberg (Univ. of Aberdeen, Scotland). Proc. Roy. Soc. (London) **A249**, 16-29(1959) Jan. 1.

A calculation of the lifetimes (τ) of excess electrons and holes in a semiconductor assuming the Auger effect between bands (electron-electron and hole-hole collisions) to be the only recombination mechanism is presented. If pair annihilation, and the corresponding reverse process of pair creation, are counted separately, there are four classes of processes to be considered. The suitably weighted algebraic sum of the rates of

these processes yields a net recombination rate R . If N be the nonequilibrium number of pairs, then $\tau = N/R$. In the calculation the effect of traps is neglected, and the group of electrons in the conduction band and the group in the valence band are each assumed to be in equilibrium among themselves, but not with each other, by the use of quasi-Fermi levels. Bloch functions $\psi_k = u(k, r) \exp(ik \cdot r)$ are used. The matrix element of the Coulomb interaction is obtained as a multiple sum over reciprocal lattice vectors. Most of these terms correspond to Umklapp-type processes whose probability of occurrence is shown to be small. The dominant term, after integration over all initial and final states, yields the dependence of lifetime on temperature, carrier concentration, energy gap and other parameters. The absolute value of the lifetime depends also on an overlap integral of the form $\int u^*(k, r) u(k', r) dr$, where k, k' are in different bands. This integral is estimated on the basis of a one-dimensional model. The theory is compared with experimental lifetimes in InSb and shows that the mechanism envisaged may dominate radiative recombination above 240°K and accounts for the order of magnitude of the observed lifetimes ($\sim 10^{-8}$ s) in the neighborhood of the highest temperature (330°K) at which recombination in InSb has so far been studied. (auth)

10235

REACTIONS OF METASTABLE ATOMS AND RESONANCE PHOTONS. J. B. Hasted and P. Mahadevan (University Coll., London). Proc. Roy. Soc. (London) **A249**, 42-50(1959) Jan. 1.

Collision experiments with $He\ 2^3S$ and $Ne\ 3P$ metastable atoms are described, giving the total collision cross-sections of these atoms and their resonance photons with He, Ne, and Ar at thermal energies. Their values are discussed in terms of energy considerations. The secondary electron yields from He metastable atoms incident upon W, Mo, and Pt surface flashed to 1700°C are compared with the yield from an unflashed Au surface, which is known absolutely from the experiments of Stebbings. The gas contamination of the surface causes the yields to rise. The absolute yields from atomically clean surfaces are calculated and compared with the data of Hagstrum for positive ions. The yields for the resonance photons have also been determined, and are compared with the data of various workers. (auth)

10236

A VARIATIONAL CALCULATION OF ELECTRONIC TRANSPORT IN A MAGNETIC FIELD. F. Garcfa-Moliner (Univ. of Cambridge, Eng.). Proc. Roy. Soc. (London) **A249**, 73-89(1959) Jan. 1.

The variational method is applied to the solution of the Boltzmann equation for an unbounded metal in a magnetic field. The formulas are thermodynamically consistent in any degree of approximation. For an anisotropic Fermi surface, a certain set of trial functions leads to an extension of Seitz's phenomenological formula, valid at arbitrary field strength for cubic crystals. At high fields the magneto-resistive effects should saturate and become isotropic. At intermediate fields the theory predicts strongly anisotropic effects in qualitative agreement with observation. At low fields the present approximation is compared with the exact theory of Jones & Zener (1934). The numerical agreement is not perfect, but the fact that the longitudinal and transverse magneto-resistance may be of the same order of magnitude is explained. (auth)

10237

THE DIFFUSION OF REACTION PRODUCTS FROM A RADIOACTIVE MONOLAYER. S. G. Mason and W. Rabinovitch (Pulp and Paper Research Inst. of Canada and McGill Univ., Montreal). Proc. Roy. Soc. (London) **A249**, 90-9(1959) Jan. 1.

The one-dimensional diffusion equation was solved for transfer at an exponentially decaying rate from an area source into a semi-infinite diffusion medium. Numerical values of the concentration distribution are given for a wide range of the values of the parameters. The solutions were used to calculate the radioactive counting rate of a diffusing radioactive substance which is being released from the surface, assuming exponential absorption of radiation by the medium. The results were used specifically to calculate the true rate of exchange of radio-iodine between a monomolecular layer of α -iodostearic acid and iodide ion in a water substrate from the measured rate of decay of radioactivity measured at the surface, but have other possible applications. (auth)

10238

VACUUM SEALS AT LIQUID-NITROGEN TEMPERATURE. J. R. Hearst, S. H. Ahn, and E. N. Straitt (Northwestern Univ., Evanston, Ill.). Rev. Sci. Instr. **30**, 200(1959) Mar.

The characteristics of several materials which are satisfactory for making vacuum seals at the temperature of liquid nitrogen are described. (A.C.)

10239

EFFECTS OF CONSTANT MAGNETIC FIELDS ON HIGH-FREQUENCY DISCHARGE IGNITION AND EXTINCTION. Kh. A. Dzhelepov. Vestnik Moskov. Univ. Ser. Mat. Mekhan. Astron. Fiz. i Khim. **13**, No. 1, 137-46(1958). (In Russian)

The effects of transverse constant magnetic fields on the ignition and extinction of a high-frequency discharge were investigated. The high-frequency discharges were excited between both plane and co-axial electrodes. The experiments were carried out in hydrogen and neon at frequencies of 1.2 and 30 Mc and at various pressures. (R.V.J.)

10240

ISOTOPIC CONVERSION IN MOLTEN RUBIDIUM AT VARIOUS TEMPERATURES. A. Lodding (Chalmers Technischen Hochschule, Göteborg). Z. Naturforsch. **14a**, 7-9(1959) Jan. (In German)

The isotope effect in the flow of direct current in molten rubidium was investigated at four temperatures, 48, 98, 142, and 265°C. The mass effect shows a distinct temperature dependence in which it increases between 50 and 100°C, but above 150°C it again decreases. (tr-auth)

10241

THE HEAT CONDUCTIVITY OF A PLASMA.

H. Schlrmer and J. Friedrich (Osram-Studiengesellschaft, Berlin). Z. Physik **153**, 563-70(1959). (In German)

The solution of the Boltzmann equation of a plasma (random ionization degree) of nonhomogeneous temperature was indicated. The solution leads to the description of the current density and heat flux of the electrons, and therefore the heat conductivity, mobility, diffusion, and thermodiffusion of the electrons were determined. All these transport coefficients are described by the magnitudes \bar{l}_0 and \bar{l}_A (as "average free path length")

and by a coupling magnitude A , which, in complete agreement of the expression of the transport coefficients for Lorentz gas and plasma, are describable by integrals for a Lorentz gas and by determinants for a plasma. (tr-auth)

10242

PRODUCTION OF A H ATOMIC BEAM WITH THE SAME DIRECTIONAL NUCLEAR SPIN. ANALYSIS OF THE BEAM, DETECTION OF THE POLARIZATION CONSERVATION. Günter Clausnitzer (Univ. of Erlangen, Ger.). Z. Physik **153**, 609-29(1959). (In German)

In connection with an earlier work (Z. Physik **144**, 336(1956)) the following questions were clarified with an atomic beam apparatus with two quadrupole fields: (1) The component moving at the center of the quadrupole field is suitable for the production of polarized protons. Non-adiabatic transitions in the fields are not within the scope of this measuring accuracy. (2) The alignment of the nuclear spin remains constant after the exit from the magnetic field. At least 80% of the hydrogen atoms of this component are spinning adiabatically in the earth's field and also in an existing magnetic field. (3) The polarization degree for the nuclear spin of the hydrogen atom in the separation from this component is 0.8 at an intensity of 10% of the unpolarized atomic beam, higher at still lower intensities. (4) The perturbing influence of the residual gas ions was estimated by orientation measurements with a Penning ion source in the atomic beam. (tr-auth)

10243

HYPERFINE STRUCTURE OF Kr^{83} . F. Bayer-Helms (Physikalisch-Technische Bundesanstalt, Brunswick). Z. Physik **154**, 175-81(1959). (In German)

The term splitting was confirmed with enriched Kr^{83} , and the hyperfine structure of several $3p$ terms was newly determined. The splitting factor of the electrons was calculated with the aid of the theory of mean coupling. (tr-auth)

10244

THE THREE AND FOUR BODY PROBLEM OF NUCLEAR PHYSICS. H. J. Mang and W. Wild (Univ. of Heidelberg, Ger.). Z. Physik **154**, 182-217(1959). (In German)

The independent pair model was applied to the nuclear three- and four-body problem. The equations of the model were solved by a perturbation approach in the case of spin- and charge-independent central two-body forces with hard core. In lowest order of perturbation theory the nuclear average potential was approximated by an oscillator potential including an effective mass, the parameters of which were chosen so as to give as nearly a self-consistent potential as possible. For a square-well two-body interaction the lowest-order equations were solved exactly, and the corrections were shown to be small. Some tests for the internal consistency of the approach were developed and were shown to be well fulfilled by the solutions. From a proposal by Lipkin, the energy of the center of mass motion was separated. The results for the binding energy of He^4 (27.9 Mev), the binding energy of H^3 (7.1 Mev), the energy difference between H^3 and He^3 (0.735 Mev), and the RMS radius of He^4 (1.75 f) are in rather good agreement with experimental results. (auth)

10245

MEASUREMENT OF THE HYPERFINE STRUCTURE SPLITTING OF BOTH YTTRIUM GROUND STATES $^2\text{D}_{3/2}$ AND $^2\text{D}_{5/2}$ WITH THE ATOMIC RADIATION RESO-

NANCE METHOD. G. Fricke, H. Kopfermann, and S. Penselin (Univ. of Heidelberg, Ger.). *Z. Physik* **154**, 218-30(1959). (In German)

With a magnetic atomic beam resonance apparatus, the high-frequency transitions between the Zeeman components of various hyperfine structure terms ($\Delta F = 1$ transition) in magnetic fields between 10 and 15 gauss and the transitions between the Zeeman components of a single hyperfine structure term ($\Delta F = 0$ transition) at field strengths between 470 and 490 gauss were measured in both ground states $^2D_{3/2}$ and $^2D_{5/2}$ of the Y^{89} atom. The magnetic hyperfine structure splitting factor was determined as $-(57.217 \pm 0.05)$ Mhz for the $^2D_{3/2}$ state and $-(28.749 \pm 0.030)$ MHz for the $^2D_{5/2}$ state. The yttrium atomic beam was detected with a universal detector. (tr-auth)

10246

MEASUREMENT OF THE ZEEMAN g_J FACTOR OF BOTH YTTRIUM GROUND STATES $^2D_{3/2}$ AND $^2D_{5/2}$ WITH THE ATOMIC RADIATION RESONANCE METHOD. Seigfried Penselin (Univ. of Heidelberg, Ger.). *Z. Physik* **154**, 231-7(1959). (In German)

The high-frequency transitions between the Zeeman components of a hyperfine structure term ($\Delta F = 0$ transitions) in magnetic fields between 470 and 490 gauss were measured in both ground states $^2D_{3/2}$ and $^2D_{5/2}$ with a magnetic atomic beam resonance apparatus. By simultaneous measurement of a corresponding transition of the $^2S_{1/2}$ ground state of Ag^{107} at equal field strengths, the ratios of the g_J factors of the ground states of Y and Ag were determined to be: $g_J(Y^{89}, ^2D_{3/2})/g_J(Ag^{107}, ^2S_{1/2}) = 0.399187 \pm 0.000013$ and $g_J(Y^{89}, ^2D_{5/2})/g_J(Ag^{107}, ^2S_{1/2}) = 0.599471 \pm 0.000033$. (tr-auth)

10247

DISSOCIATION OF THE MOLECULAR ION H_2^+ IN COLLISIONS WITH GASES. N. V. Fedorenko, V. V. Afrosimov, R. N. Il'in, and D. M. Kaminker (Leningrad Inst. of Physics and Tech., Academy of Sciences, U.S.S.R.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 385-92(1959) Feb. (In Russian)

Measurements were made of the cross sections $\sigma_{H_2^+}$ for the formation of protons as a result of dissociation of molecular hydrogen ions H_2^+ in single collisions occurring in helium, argon, hydrogen, or air. The energy (T) of the H_2^+ ions varied between 5 and 180 kev. For hydrogen and helium the curves $\sigma_{H_2^+}(T)$ possess two maxima. For argon and air the curve continually increases with increase of the energy in the interval mentioned above. The angular distribution of primary 24 kev H_2^+ ions scattered in argon without a change of e/m was investigated as well as the distribution of H^+ and H^- ions formed as the result of dissociation. It is concluded that with decrease of the distance of closest approach of the nuclei of the colliding atomic particles the relative probability of scattering with dissociation increases. (auth)

10248

ON THE RELATIVE PROBABILITIES FOR THE PHOTOEFFECT IN SHELLS AND SUBSHELLS OF AN ATOM. E. P. Grigor'ov and A. V. Zolotavin (Leningrad State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 393-400 (1959) Feb. (In Russian)

The relative intensities of the K, $L_I + L_{II}$, L_{III} , and M + N photoelectron lines produced by γ rays from some radioactive isotopes in various targets were determined with a β spectrometer possessing a resolution

of 0.4%. The results are compared with theoretical calculations. (auth)

10249

PLASMA ACCELERATION. I. S. Shpigel (Lebedev Inst. of Physics, Academy of Sciences, U.S.S.R.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 411-15(1959) Feb. (In Russian)

A plasma was accelerated in vacuum in an axially symmetrical, inhomogeneous, pulsed magnetic field. The density of the plasma clusters exceeded 10^{12} particles/cm³. The peak energy of nitrogen and oxygen atomic ions was ~ 190 ev, of helium ions ~ 280 ev, and of hydrogen atomic ions ~ 120 ev. (auth)

10250

ON THE BEHAVIOR OF A CONDUCTING GASEOUS SPHERE IN A QUASISTATIONARY ELECTROMAGNETIC FIELD. V. V. Yankov (Lebedev Inst. of Physics, Academy of Sciences, U.S.S.R.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 560-4(1959) Feb. (In Russian)

The stability of an infinitely conducting homogeneous plasmic sphere in an external quasistationary electromagnetic field is investigated by perturbation theory methods. (auth)

10251

THE INFLUENCE OF THE ELECTRON-PHONON INTERACTION ON THE CYCLOTRON RESONANCE FREQUENCY. A. V. Tulub (Leningrad State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 565-73(1959) Feb. (In Russian)

The phonon-electron interaction in polar crystals gives rise to the nonlinear dependence of the cyclotron resonance frequency on the magnetic field. The calculation of this term shows that it is small for practically used fields. The polaron effect leads also to a correction in diamagnetic susceptibility. The mass renormalization in the presence of the magnetic field is performed without assuming the coupling constant to be small. (auth)

10252

ON THE COMPENSATION EQUATION IN SUPERCONDUCTIVITY THEORY. D. V. Shirkov (Steklov Math. Inst., Academy of Sciences, U.S.S.R.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 607-12(1959) Feb. (In Russian)

A relation is established between the matrix elements of the variational derivatives of the scattering matrix and energy operator. With the help of this relation the kernel of the integral equation for compensation of "dangerous" diagrams is expressed through the usual Green's functions. (auth)

10253

ACCELERATION OF CHARGED PARTICLES IN MOVING AND STANDING ELECTROMAGNETIC WAVES. G. A. Askar'yan (Lebedev Inst. of Physics, Academy of Sciences, U.S.S.R.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 619-21(1959) Feb. (In Russian)

General conditions under which a sufficiently large, average magnitude, one-sided force acts on a particle in a moving or standing wave were investigated. It is shown that by a special selection of resonance frequency and dissipation coefficient it is possible to achieve a directed penetration through a standing wave, spatially periodic field independent of the sign of the charge. The transition through the standing wave does not permit a sharp power reduction in the feeding aggregate and secures effective acceleration of the rarefied nongrouped or weakly grouped plasma. (R.V.J.)

10254

INSTABILITY AND HYSTERESIS OF ELECTRON PLASMA IN INERT GAS PLASMA. A. V. Gurevich (Lebedev Inst. of Physics, Academy of Sciences, U.S.S.R.). *Zhur. Eksptl'. i Teoret. Fiz.* 36, 624-6(1959) Feb. (In Russian)

It was shown previously that an electron gas remains stationary in relation to ions only in small intensity electric fields $E < E_k$; with $E \geq E_k$ it becomes unstable. A similar instability takes place in a low-frequency, alternating field. However, in this case a secondary stability appears with a rise in temperature. Transitions from the first state to the next and back again take place at various electrical field amplitudes which lead to an electron temperature hysteresis dependence. The static electron temperature T_e was calculated for weakly and strongly ionized plasma. The secondary stability appearing at high electron temperatures is due to an increased electron-atom interaction frequency at high rates ($v > 5 \times 10^7$ cm/sec). The maximum field magnitudes for transitions from the first state to the second and back differ slightly. $E_{k1} = 8.4 \times 10^{-3} p$, $E_{k2} = 7.4 \times 10^{-3} p(v/\text{cm})$, where p is gas pressure in mm. The hysteresis loop is consequently also small. (R.V.J.)

10255

THE ISOTOPIC SHIFT IN UH_3 AND UD_3 CURIE POINT. A. I. Karchevskii, E. V. Artyushkov, and L. I. Kikoin. *Zhur. Eksptl'. i Teoret. Fiz.* 36, 636-7(1959) Feb. (In Russian)

The residual magnetization of uranium hydride and deuteride specimens was studied in order to obtain preliminary data on the Curie point shift. (R.V.J.)

10256

THE MAGNETOCALORIC EFFECT IN UH_3 AND UD_3 . A. I. Karchevskii. *Zhur. Eksptl'. i Teoret. Fiz.* 36, 638-9(1959) Feb. (In Russian)

A method was developed for measuring magnetocaloric effects in the powder specimens of UH_3 and UD_3 . Measurements were made in magnetic fields of various intensities (up to 17,000 gauss). The magnetocaloric effects in powdered Ni, CrTe, and MnSb were measured for verification of the method. A graph of the temperature dependence taken in a 17,000-gauss magnetic field shows maxima corresponding to the Curie ferromagnetic temperatures, $\theta_{\text{UH}_3} = 182.0$ and $\theta_{\text{UD}_3} = 178.4^\circ\text{C}$. (R.V.J.)

10257

THERMODYNAMIC PROPERTIES OF DEGENERATE PLASMA. A. A. Vedenov (Moscow State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* 36, 641-2(1959) Feb. (In Russian)

The diagram technique for Green's statistical functions in quantum statistical physics was applied to interaction corrections for the thermodynamic potential Ω in completely ionized hydrogen plasma. The electron plasma is considered as a Fermi gas and nuclei from a Boltzman gas. (R.V.J.)

10258

ELECTRIC DISCHARGE WITH COLD CATHODE IN MAGNETIC FIELD AT LOW PRESSURE. G. V. Smirnitckaya and E. M. Reikhrudel (Lomonosov Moscow State Univ.). *Zhur. Tekh. Fiz.* 29, 153-62(1959) Feb. (In Russian)

Studies were made of electric discharge in a low-pressure magnetic field with cold cathode plates symmetrically distributed at each side of a ring anode.

The kinetics of electrons in an undisturbed field was evaluated. The distribution of the potential was found, and the electron trajectories with arbitrary initial coordinates and velocities were obtained in various electric and magnetic field correlations. The dependence of ignition potential on magnetic field was evaluated in order to verify theoretical studies. (R.V.J.)

10259

CORRELATIONS FOR THE DIRECT CURRENT IN MANY-RAY ONE-DIMENSIONAL ELECTRONIC FLOW. Chzhan Dshi-min (Moscow State Univ.). *Zhur. Tekh. Fiz.* 29, 163-9(1959) Feb. (In Russian)

Correlations were found for double-ray flow which appear to be generalizations of known formulas for a single flow. (tr-auth)

10260

ON THE THEORY OF WAVE PROPAGATION IN IRREGULAR WAVEGUIDES. G. Ya. Lyubarskii and A. Ya. Povsner (Inst. of Physics and Tech., Academy of Sciences, Khar'kov, Ukrainian S.S.R.). *Zhur. Tekh. Fiz.* 29, 170-9(1959) Feb. (In Russian)

A generalized formula for the wave propagation constant was used in studies of acoustic wave propagation through an irregular waveguide, for the case where the angle magnitude arbitrarily changes within wide limits but at very slow rates. The method is also applied in evaluating the electromagnetic waveguides. (R.V.J.)

10261

THE GAS PARAMETERS AFTER A SHOCK WAVE. Yu. P. Lunkin (Leningrad Inst. of Physics and Tech.). *Zhur. Tekh. Fiz.* 29, 180-8(1959) Feb. (In Russian)

Calculations of alternating heat capacity indicate that the gas parameters behind the shock wave are determined by an effective γ and by $\gamma = C_p/C_v$. In the case of gases with ion dissociative energy and small γ the corresponding "frozen" and equilibrated adiabates and polars are intersecting. (R.V.J.)

10262

ELECTRON RELAXATION PROCESSES IN TITANIUM DIOXIDE. L. I. Reimerov (Ul'yanov (Lenin) Leningrad Electrotechnical Inst.). *Zhur. Tekh. Fiz.* 29, 261-6(1959) Feb. (In Russian)

Some defects occur in rutile during the partial reduction of TiO_2 or during the introduction of certain admixtures. The electron energy schemes in the defect region are plotted considering the polarization of the media. The electron states described give rise to relaxation processes with time $t = 10^{-8}$ to 10^{-4} sec at room temperature. (R.V.J.)

10263

EMISSION OF VOLUME AND SURFACE COMPRESSION WAVES DURING THE COLLISIONS OF A NONRELATIVISTIC ELECTRON FLOW WITH THE SURFACE OF A DENSE MEDIUM. G. A. Askaryan. *Zhur. Tekh. Fiz.* 29, 267-9(1959) Feb. (In Russian)

The generation of volume waves during nonrelativistic electron beam collisions with dense surfaces is investigated. The observed volume wave emissions induced by the local dissipation of pulses and by electron energies are quite intense due to the sudden attenuation bremsstrahlung processes, small dissipation areas, and the high-density attenuating region. The nonrelativistic electron bombardment of a foil with sufficient thermoelectrical conductivity is followed by a noticeable hypersonic nonchromatic volume wave emission and

strongly attenuating surface waves giving rise to a ripple on the bombarded surface. Two methods of coherent amplification of volume emission are analyzed: the modulation of electron flux density (which secures coherent emission) and the surface layer distortion (which secures a coherent cumulative superimposition of the emitted waves in the focusing zone). (R.V.J.)

10264

SHOCK WAVES IN REAL GASES. Yu. P. Lunkin (Leningrad Inst. of Physics and Tech.). *Zhur. Tekh. Fiz.* 29, 272-3(1959) Feb. (In Russian)

An effective sign γ is introduced into the equations of conservation and equation of state which describe shock waves in real gases. It is shown that in real gases the parameters behind the shock waves can also be determined by γ , and the intersection of corresponding shock adiabates and shock polarities is also possible. (R.V.J.)

10265

RELATION OF THE ABSORBED ENERGY AND IONIZATION FOR γ -QUANTA WITH $E_{\gamma, \max} = 85$ Mev. S. P. Kruglov and I. V. Lopatin (Leningrad Inst. of Physics and Tech.). *Zhur. Tekh. Fiz.* 29, 273-5(1959) Feb. (In Russian)

The proportionality between absorbed energy and ionization in lead was studied. Comparisons were made of γ beam energy absorption in a target of finite thickness with results from transition curves. A special calorimeter was developed for measuring the absorbed energy, and measurements were made on lead targets of 4, 7, 14, and 30 mm. Gamma rays from a synchrotron with maximum energy $E_{\gamma} = 85$ Mev were used. It was found that the results depend strongly on the distance between the target and calorimeter cylinders. The data on the relation between the target thickness, absorption energy, and the weakening of the γ beam intensity are tabulated for lead, graphite, aluminum, and copper. (R.V.J.)

10266

ELECTROMAGNETIC PHENOMENA IN COSMICAL PHYSICS. International Astronomical Union Symposium No. 6, held in Stockholm, August 1956. B. Lehnert, ed. Cambridge, Eng., University Press, 1958. 554p.

Theoretical and experimental papers were presented on fundamental magnetohydrodynamics including currents in gases in the presence of a magnetic field, stellar magnetism, and electromagnetic phenomena within the solar system. Solar-electrodynamics, magnetic storms and aurorae, and cosmic-ray intensity variations are included. (W.D.M.)

10267

RADIOISOTOPES IN SCIENTIFIC RESEARCH. VOLUME I. RESEARCH WITH RADIOISOTOPES IN PHYSICS AND INDUSTRY. Proceedings of the International Conference held in Paris in September 1957 under the Auspices of the United Nations Educational Scientific and Cultural Organization. R. C. Extermann, ed. New York, Pergamon Press, 1958. 779p.

Fifty-five papers are presented. Topics covered include the production of radioisotopes, radiation dosimetry, the design and use of strong sources, metallurgy, industrial applications, solid state physics, measuring methods and techniques, the longitudinal polarization of beta particles, the capture of reactor neutrons in chlorine-37, and the role played by radioisotopes in parity investigations. A complete subject index is included. (C.H.)

10268

STUDY OF THE PRIMARY COSMIC RADIATION BY USING ARTIFICIAL SATELLITES OF THE EARTH. S. N. Vernov, V. L. Ginzburg, L. V. Kurnosova, L. A. Razorionov, and M. I. Fradkin. p. 464-77 in "VIIIth International Astronautical Congress, Barcelona, 1957, Proceedings." F. Hecht, ed. Vienna, Springer-Verlag, 1958. 612p.

The use of artificial satellites to investigate cosmic-ray time variations of different kinds and the charge-spectrum of the primary cosmic rays is discussed. Investigation of the interactions of cosmic particles with nuclei in the upper atmosphere by the use of satellites is presented. The instruments carried by the satellites are also reported. (W.L.H.)

10269

ON THE GENERATION OF TEMPERATURES TO 30,000°K. Peter E. Glaser (Arthur D. Little, Inc., Cambridge, Mass.). p.147-55 in "VIIIth International Astronautical Congress, Barcelona 1957, Proceedings." F. Hecht, ed. Vienna, Springer-Verlag, 1958. 612p.

The drawbacks of conventional methods of heating materials are briefly touched upon, and various techniques for heating materials without crucibles and in controlled atmospheres are pointed out. The convenience of using electromagnetic radiation from a suitable source instead of the source environment itself and the research applications of furnaces using solar energy and high-intensity electric arcs are discussed in some detail. The techniques of the stabilized-gas vortex arc are described and the temperature limits mentioned. (W.L.H.)

10270

SKHEMY RASPADA RADIOAKTIVNYKH YADER. (Decay Schemes of Radioactive Nuclei.) B. S. Dzhelepov and L. K. Peker. Moscow-Leningrad, Academy of Sciences of the USSR Press, 1958. 784p.

The schemes represent a complete list of all radioactive and stable isotopes of the elements, together with their salient features, and serve as a supplement to "Tables of Isotopes" by Hollander, Perlman, and Seaborg. Data obtained up to the middle of 1957 are given, and references published since the beginning of 1950 are cited. An introduction in English and the use of the Roman alphabet throughout the book permit its use without any knowledge of Russian. (TCO)

Elementary Particles

10271 AD-210568

Pittsburgh. Univ. Sarah Mellon Scaife Radiation Lab. RESEARCH ON THE PHYSICAL PROPERTIES OF PHOTONS, ELECTRONS AND POSITRONS. Final Report [for] November 1, 1956 through October 31, 1958. L. A. Page and F. E. Obenshain. 58p. DA Project 5B99-01-004. Contract DA-36-ORD-559.

Research is summarized and publications are listed. Research topics include (1) search for $n = 2$ positronium, (2) longitudinal polarization of Na^{22} positrons, (3) polarization detection for stopped positrons (Doppler method using free positronium, positronium in plastics, iron detector for positron polarization), (4) polarization detection for energetic positrons, (5) helicity of neutrinos, (6) v/c dependence of polarization in beta decay, and (7) effect of an electrostatic field on positronium. A paper on detection of a $\sigma \cdot E$ energy shift in positro-

nium formed from polarized positrons is included.
(auth)

10272 AECU-4034

California. Univ., Berkeley.

LOW-ENERGY π -MESONS IN THE COSMIC RADIATION. Cosmic Rays Technical Report No. 41. Feb. 2, 1959. Mircea Fotino. 48p. Sponsored by ONR and AEC under Contract Nonr-222(40). \$7.80(ph), \$3.30(mi) OTS.

The intensity of π mesons in the atmosphere is investigated in the energy region $E_{\text{kin}} \lesssim 50$ Mev at sea level and mountain altitudes. Positive π mesons coming to rest in an absorber-scintillator are identified by the characteristic π - μ decay. They are detected electronically and recorded photographically. The value 1.45 ± 0.09 is adopted for the negative-to-positive ratio at small energies. The omnidirectional intensities J_{π}^{\pm} of slow positive π mesons at sea level (91 m), Echo Lake, Colorado (3260 m), and Mt. Evans, Colorado (4310 m), are found to be 0.0094 ± 0.0024 , 0.098 ± 0.005 , and $0.240 \pm 0.011 \text{ g}^{-1}\text{d}^{-1}$, respectively. The altitude dependence of J_{π}^{\pm} , J_{μ}^{\pm} and $J_{\pi}^{\pm}/J_{\mu}^{\pm}$ is given, and the attenuation length of slow π mesons in the atmosphere was found to be $L_{\pi}^{\pm} \approx 120$ -130g/cm² in this altitude interval. A discussion covering most of the available results along the same line is presented. (auth)

10273 CNC-6

Italy. Comitato Nazionale per le Ricerche Nucleari, Milan.

SULLA DIPENDENZA DALLA TEMPERATURA DELLA LUNGHEZZA DI DIFFUSIONE DI NEUTRONI TERMICI IN ACQUA. (The Dependence of the Temperature on the Length of the Thermal Neutron Diffusion in Water.) V. Benzi. Dec. 1958. 9p.

The temperature dependence of thermal neutron diffusion length in water is discussed. The Radkowsky phenomenological proposal was modified to take into account the Doppler effect. Theoretical values were obtained which are in agreement with experimental values. (auth)

10274 NP-7333

Padua. Università and Italy. Istituto Nazionale di Fisica Nucleare, Padua.

A TENTATIVE EVALUATION OF THE $N \Xi$ MASS DIFFERENCE. N. Dallaporta and G. Patergnani. [1958]. 10p.

The interpretation of the scheme of elementary particle states has principally consisted of a search of symmetries to which the regularities for the charge states, the coupling types, and the values of the interaction constants could be attributed. Several models based on some highly symmetric Lagrangians have been proposed. Recent investigations indicate that these postulated symmetries are less general than was first supposed. While most of the work has been principally directed to the explanation of the irregularities of the interactions, the present effort is an attempt to interpret the mass splitting of the baryon levels. (A.C.)

10275 WADC-TN-59-83

Wright Air Development Center. Propulsion Lab., Wright-Patterson AFB, Ohio.

THE AVERAGE LOGARITHMIC ENERGY DECREMENT AND THE AVERAGE VALUE OF THE COSINE OF THE SCATTERING ANGLE OF ELASTICALLY SCATTERED NEUTRONS, CORRECTED FOR ANISOTROPIC SCATTERING. Arthur L. Kaplan. Feb. 1959. 11p. Project 3104-30375.

A general polynomial expression for the probability of elastically scattering a neutron at a given angle to its original path of motion is used in deriving equations for the average logarithmic energy decrement and the average value of the cosine of the scattering angle for elastically-scattered neutrons. This is an extension of a previous study in which the probability expressions for s-, p-, and d-scattering only were used. The resulting equations agree with those appearing in the report of the previous study when the proper indices on the summations in these equations are used. Since these equations are in a convenient form for programming on a digital computer, numerical values can easily be obtained for any chemical element, once the "best-fit" polynomial for the angular dependence of the elastic scattering cross section for the element is established. (auth)

10276

ATMOSPHERIC EFFECTS ON COSMIC RAY INTENSITY AT SEA LEVEL. P. M. Mathews (National Research Council, Ottawa). Can. J. Phys. 37, 85-101(1959) Feb.

Cosmic-ray intensity variations of primary origin and those caused by meteorological changes appear superposed in records obtained from meson counter telescopes and neutron monitors at sea level. The study of either of these types of variation is thus greatly complicated by the presence of the other. In the present work, for the first time the step of processing the raw data to eliminate primary variations (and the inherent statistical fluctuations) so as to make possible a direct comparison of the remaining variations with the changes in atmospheric variables over the same period was taken. The subsequent analysis confirms the expectation that there are no appreciable atmospheric effects on the intensity of the nucleonic component beyond the well-known effect associated with the sea level barometric pressure B . But in the meson case there is strong evidence that the widely used set of variables H_{100} , T_{100} (the height and temperature of the 100-mb level) and B is not very suitable for representing atmospheric effects; it seems essential to include a variable representing temperatures in the lower part of the atmosphere, and the set of variables T_{800} (temperature of the 800-mb layer), H_{100} , and B , with coefficients $k_T = -.082 \pm .008\%/^{\circ}\text{C}$, $k_H = -3.04 \pm .61\%/ \text{km}$, and $k_B = -.134 \pm .004\%/\text{mb}$ appears to be the best. The theoretical formula of Dorman (1957), with a barometric coefficient $\beta = -.147 \pm .004\%/\text{mb}$ and with the term representing the "temperature effect" reduced by a factor $.76 \pm .03$, gives slightly better results. However, the improvement, at least in the case of the data analyzed, is too small to justify the great labor involved in using this formula. (auth)

10277

IONIZATION LOSS BY COSMIC-RAY MU-MESONS IN ARGON. Georges Hall (Univ. of Laval, Quebec). Can. J. Phys. 37, 189-202(1959) Feb.

The ionization of argon by cosmic-ray μ -mesons of minimum specific ionization was studied by means of a calibrated pressure-ionization chamber using electron collection. Corrections which are shown to be necessary have been applied to the experimental data. The shape of the experimental curve of statistical distribution of energy loss agrees with the theoretically predicted shape, for energy losses greater than the most probable loss (300 kev). (auth)

10270

DIFFUSION OF A CHARGED PARTICLE IN HYDROGEN. Marcel Demeur and Paul Janssens. Compt. rend. **248**, 1132-5 (1959) Feb. 23. (In French)

The differential and total cross sections and the energy loss by electron excitations and ionization are calculated by the Born approximation for different central potentials representing the hydrogen atom and molecule. (tr-auth)

10279

RADIATION FROM A MODULATED BEAM OF CHARGED PARTICLES WHEN PASSING THROUGH A CIRCULAR HOLE IN A PLANE SCREEN. Yu. N. Dnestrovskii and D. P. Kostomarov (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. **124**, 792-5 (1959) Feb. 1. (In Russian)

The radiation from a modulated electron beam passing through a circular hole in an infinitely fine, ideally conducting screen was calculated in the velocity range from $\beta = 0.1$ to $\beta = 0.99$ ($\beta = v/c$). The integral equation solution was programmed on a computer. (R.V.J.)

10280

RADIATION OF ULTRA-RELATIVISTIC CHARGES WHEN PASSING THROUGH A CIRCULAR HOLE IN A SCREEN. Yu. N. Dnestrovskii and D. P. Kostomarov (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. **124**, 1026-9 (1959) Feb. 11. (In Russian)

Previously derived asymptotic formulas are applied for evaluating the radiation emitted by an axially symmetric charge passing through a circular aperture. The charge motion is considered as a unit moving with a constant ultra-relativistic velocity. The maximum radiation density was found to be in the low-frequency regions. The results obtained can be used for evaluating the energy emitted in accelerators by particles passing near geometrical heterogeneities in accelerating intervals. (R.V.J.)

10281

RADIATION FROM A POLARIZED LUMINOUS ELECTRON. I. M. Ternov and V. S. Tumanov (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. **124**, 1038-41 (1959) Feb. 11. (In Russian)

The radiation from a polarized relativistic electron in a constant, uniform magnetic field was studied. The wave function of the electron moving in the magnetic field is taken as the solution to the Dirac equation and the natural function of spin operator projection on the kinetic pulse. The selection of such a wave function is justified by the fact that the electron spin orientation in relation to the direction of its motion in the magnetic field remains constant. (R.V.J.)

10282

MEASUREMENT OF THE MULTIPLE SCATTERING OF π MESONS STOPPED IN NUCLEAR EMULSIONS BY THE TANGENT METHOD. Brigitte Depaux (Faculté des Sciences, Paris). J. phys. radium **20**, 16-19 (1959) Jan. (In French)

The multiple scattering of 40 π mesons which came to rest in a G5 nuclear emulsion was measured by means of the tangent method. The direction of a double cell can be determined from the mean direction of two consecutive single cells forming the double cell. The noise between double and single cells was thus eliminated. Formulas proposed for the elimination are verified by this study. The multiple scattering constant

deduced from the study of π mesons of energy 6 to 12 Mev is, within experimental error, in good agreement with the theoretical value. The distribution of scattering angles is gaussian for angles 4 times smaller than the mean angle, but for greater angles, there is a significant excess. The ratio between the second difference and the angle of multiple scattering is of the same order as that found by the sagitta method. (auth)

10283

DETERMINATION OF THE AVERAGE ENERGY LOSS W_L FOR BETA PARTICLES IN AIR. G. Brunner (Deutschen Akademie der Wissenschaften, Leipzig). Naturwissenschaften **46**, 9 (1959). (In German)

A determination of the energy loss of beta particles in air was made using an extrapolation chamber with a liquid beta emitting electrode. In addition to the pure beta emitters P^{32} , Y^{90} , and Tl^{204} , the beta-gamma emitters Na^{24} , Co^{60} , and Br^{82} were used in water solution. The results for each nuclide is graphed, and a value of $W_L = 33.9 \pm 0.5$ ev was obtained. (J.S.R.)

10284

ON THE MASSES OF ELEMENTARY PARTICLES. Abdus Salam and J. Tiomno (Imperial Coll., London). Nuclear Phys. **9**, 585-7 (1959) Jan. (2).

Some speculations about self-masses of elementary particles are presented. (auth)

10285

A NOTE ON THE DECAY OF THE Σ -HYPERON AND ITS ANTIPARTICLE. Chou Kuang-Chao (Joint Inst. of Nuclear Research, Dubna, USSR). Nuclear Phys. **9**, 652-4 (1959) Jan. (2).

The information which may be derived from measurements of the branching ratios and angular correlation of Σ^- and $\bar{\Sigma}^-$ decays is examined. (auth)

10286

SYMMETRIES OF LEPTONIC INTERACTIONS. I. Saavedra (Univ. of Manchester, Eng.). Nuclear Phys. **10**, 6-19 (1959) Feb. (1)

It is proved that leptonic processes can be described in isospace by using spinorial representations of the rotation group, and that the procedure is consistent with the general formalism and with the experimental data. (auth)

10287

THE ISOBARIC SELECTION RULE FOR HYPERONS AND K-MESONS. Kimiko Nakagawa (Univ. of Tokyo). Nuclear Phys. **10**, 20-7 (1959) Feb. (1)

The weak decay processes for hyperons and K-mesons are analyzed to test the isobaric selection rule $|\Delta I| = \frac{1}{2}$. It is shown that only one possible type is left for the Σ -decay interaction when the rule $|\Delta I| = \frac{1}{2}$, the T-invariance and the one-to-one law are assumed. (auth)

10288

THE EFFECTIVE ATOMIC FIELD FOR ELECTRON SCATTERING. E. van der Spuy (Univ. of Stellenbosch). Nuclear Phys. **10**, 53-9 (1959) Feb. (1)

A discussion is given of a correction to the atomic field effective in, for example, electron polarization experiments by double scattering. The correction is aimed at suggesting an explanation of the low azimuthal asymmetry found in such experiments compared with the Mott theory. It is shown to be a many-body problem in which proper recognition of the role of the exclusion principle gives an effective modi-

fication of the screened Coulomb field normally used in electron scattering calculations, and in fact at such radii as would have an important effect on the most important phase shifts in such a scattering problem. (auth)

10289

ON THE THEORY OF DISPERSION RELATIONS FOR VIRTUAL PROCESSES. A. A. Logunov (Joint Inst. of Nuclear Research, Dubna, USSR). Nuclear Phys. **10**, 71-81(1959) Feb. (1)

A deduction of the dispersion relations for virtual photoproduction is presented. (auth)

10290

THE RENORMALIZABILITY OF VECTOR MESON INTERACTIONS. Sheldon L. Glashow (Univ. of Copenhagen). Nuclear Phys. **10**, 107-17(1959) Feb. (2)

A new and less restrictive criterion is deduced for the renormalizability of vector meson interactions. As an example, the electromagnetic interaction of a charged vector meson with unit anomalous magnetic moment is shown to be renormalizable. In order to construct a renormalizable theory of the elementary-particle decays in which such a particle plays the role of an intermediary, it is found necessary to assume an intimate connection between decay-inducing and electrodynamic interactions. (auth)

10291

HIGH ENERGY NUCLEON-DEUTERON ELASTIC SCATTERING AND THE NUCLEON-NUCLEON FORCES. Jerzy Sawicki and Shiguo Watanabe (Princeton Univ., N. J.). Nuclear Phys. **10**, 151-9 (1959) Feb. (2)

The differential cross sections and the polarization are calculated for 100 and 40 Mev nucleons elastically scattered from deuterons. A kind of impulse approximation is used with the elementary scattering operators corresponding to the phase shifts resulting from Gammel-Thaler and Marshak-Signell potentials. The results for both cases are compared with the existing experimental data. (auth)

10292

MESON PRODUCTION IN NUCLEON-NUCLEON COLLISIONS. Alladi Ramakrishnan, N. R. Ranganathan, and S. K. Srinivasan (Univ. of Madras, India). Nuclear Phys. **10**, 160-5(1959) Feb. (2)

A calculation of the amplitude for meson production in a nucleon-nucleon collision is presented using the method of Low. By making a suitable Tamm-Dancoff approximation, the matrix element for the process is expressed in terms of the two nucleon potential, pion nucleon scattering matrix element, and nucleon vertex operator. (auth)

10293

A DEVELOPMENT OF THE GIBBS POTENTIAL OF A SYSTEM COMPOSED OF A LARGE NUMBER OF PARTICLES. II. Claude Bloch and Cyrano de Dominicis (Commissariat à l'Energie Atomique, Paris). Nuclear Phys. **10**, 181-96(1959) Feb. (2) (In French)

The expansion of the Gibbs potential in powers of the activity is derived with the use of the second quantization, reestablishing a result of Ward and Montroll and the link with the classical Ursell-Yvon-Mayer expansion. Partial summation of non-interacting "loops" leads to the expansion established in a previous paper.

This expansion can be cast into a form in which a "reduced potential," temperature and activity dependent, replaces the usual interaction. All contributions are then given by the (connected) "irreducible" diagrams only. (auth)

10294

BOUND STATES IN MESON PAIR THEORY (A POSSIBLE PHYSICAL MODEL OF HYPERONS). G. Györgyi (Central Research Inst. for Physics, Budapest). Nuclear Phys. **10**, 197-202(1959) Feb. (2)

Bound states in meson pair theory were investigated in the strong cut-off lattice space approximation of Wentzel under the assumption of a vector coupling. The problem under consideration may serve as a model field theory of the " $\bar{N}K$ " hyperon model previously suggested. (auth)

10295

USE OF THE DEPENDENCE OF THE DECAY LAW OF ORGANIC SCINTILLATORS ON THE DENSITY OF EXCITATION FOR THE DISCRIMINATION OF FAST NEUTRONS FROM THE γ BACKGROUND. M. Forte (Laboratori CISE, Milan). Nuovo cimento (10) **9**, Suppl. No. 2, 390-7(1958). (In Italian)

A description is given of an apparatus used to distinguish the fast neutron pulses from a Po-Be source from a natural γ background or produced with Cs^{137} , Ra, or Th sources. From the experiments information was obtained on the emission characteristics of various scintillators excited by neutrons. The results, which are tabulated, show that in the scintillations produced by recoil protons the fraction of light emitted beyond a time, which is a characteristic of the scintillator used, is appreciably greater than in the case of excitation by electrons. This slow component of the scintillation can be used to discriminate neutrons from a gamma background. (J.S.R.)

10296

THE SCATTERING CONSTANT FOR MULTIPLY CHARGED PARTICLES IN PHOTOGRAPHIC EMULSION. C. Fichtel and M. W. Friedlander (Washington Univ., St. Louis). Nuovo cimento (10) **10**, 1032-8(1958) Dec. 16.

Numerical values were calculated for the scattering constant for multiply charged particles in photographic emulsion. The constant was calculated both with and without cut-off being applied for correction for single scattering, and the results are presented in graphical form. (auth)

10297

INTERACTION AT LOW ENERGIES OF π^+ MESONS IN PHOTOGRAPHIC PLATES. A. Minguzzi and A. Minguzzi-Ranzi (Univ. Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10) **10**, 1100-8(1958) Dec. 16.

The interactions of π^+ -mesons, in the energy range (0 to 60) Mev, in nuclear emulsions is investigated. The model which assumes that the pion absorption in nuclei occurs via a neutron proton pair is discussed. (auth)

10298

PHOTOPRODUCTION OF CHARGED PIONS IN DEUTERIUM. M. Beneventano, G. Bernardini, G. Stoppini, and L. Tau (Univ. of Rome, Istituto Nazionale di Fisica Nucleare, Rome, and Univ. of Illinois, Urbana). Nuovo cimento (10) **10**, 1109-42(1958) Dec. 16.

An experimental analysis of the process



is presented. The $\sigma(-)/\sigma(+)$ ratio was measured in the photon energy interval (170 to 230) Mev and lab. angles 45, 75, 105, and 150°. The results are interpreted on the base of the impulse approximation with the aim of getting information on the process $h\nu + n \rightarrow \pi^- + p$. (auth)

10299

ENERGY DEPENDENCE OF THE ASYMMETRY PARAMETER OF $\pi-\mu-e$ DECAY IN NUCLEAR EMULSIONS. C. Besson and V. Brisson-Fouché (Ecole Polytechnique, Laboratoire de Physique, Paris). Nuovo cimento (10) 10, 1143-5 (1958) Dec. 16.

Some 915 $\pi^+-\mu-e$ decays at rest found in emulsions exposed to the Chicago synchrocyclotron beam were investigated. Experimental asymmetry values are given for five energy groups in the range 0 to 55 Mev; the mean value integrated over the entire spectrum was $a = 0.171 \pm 0.058$. The experimental energy spectrum of positrons from the decays is also given; the Michel parameter was calculated to be $\rho = 0.67 \pm 0.14$ (D.E.B.)

10300

INTERPRETATION OF JETS WITH THE MODEL OF EXCITED NUCLEONS. J. Burmeister, K. Lanius, and H. W. Meier (Deutsche Akademie der Wissenschaften, Berlin and Kernphysikalisches Institut Zeuthen, Berlin). Nuovo cimento (10) 11, 12-20 (1959) Jan. 1. (In German)

A method for the determination of γ_c in nucleon-nucleon collisions of very high energy based on the model of excited nucleons is presented. Isotropic angular distribution of the secondary particles in the center of mass systems of the emitting nucleons is assumed. The energy of all secondaries is assumed to be the same in both systems. Relations for γ_c and the Lorentz factor γ' of the nucleon after the collisions in the center of gravity frame of reference are given. The γ_c values computed for a great number of high energy jets are compared with the values following from the statistical method of Castagnoli et al. A comparison is made with the data given by Koba for the multiplicity in the two center model. The relations recently presented by Tschernawski for the Heisenberg case of π -N-collisions are in good agreement with assumptions. (auth)

10301

INVESTIGATION OF NUCLEAR INTERACTIONS OF ENERGIES BETWEEN 10 AND 100 Gev. E. Fenyves, E. Gombosi, and P. Surányi (Central Research Inst. of Physics, Budapest). Nuovo cimento (10) 11, 21-5 (1959) Jan. 1.

The angular and energy distribution of shower particles of seven nuclear interactions, mostly complex collisions, were measured. The Lorentz factor γ_{cm} of the center of mass system (CMS) was determined from the energy of secondaries and the Lorentz factor γ_{sym} of the symmetry system was obtained from the angular distribution. It was found that $\gamma_{sym}/\gamma_{cm} = 0.92 \pm 0.15$, which corresponds to a symmetrical emission of shower particles in the CMS. Energy distributions in the CMS as well as transversal momentum distribution of shower particles were also determined. (auth)

10302

ON THE INTERPRETATION OF COSMIC RAY JETS: THE "FUNNEL" MODEL. T. Gozani and K. Sitte (Israel Inst. of Tech., Haifa). Nuovo cimento (10) 11, 26-43 (1959) Jan. 1.

Arguments are presented in favor of the interpretation of cosmic-ray jets as composite collisions, in a single act, of the primary with a compound of target nucleons. In particular, it is pointed out that the identity of successive collisions is lost at high energies, because the expanding meson cloud enwraps the compound before ejecting the bulk of the secondaries. According to this view, the primary energies assigned to the jets by the customary procedures are too low in many cases, and especially for events with large numbers N_h of heavy prongs. The resulting difference in the true primary energies of the jets with $N_h \leq 3$ and $N_h > 3$ accounts for the apparently excessive frequency of the events of low N_h . But if the model of the nucleus as an aggregate of corpuscles is retained, the cross section of the avalanche of interacting nucleons will increase with penetration, and the usual picture of the interaction volume shaped like a cylindrical tunnel must be replaced by that of an inverted funnel. This funnel model predicts a stronger dependence of the multiplicities on the atomic weight of the target nucleus, and seems to fit the rather scanty experimental data somewhat better. It is then shown that according to this model, the larger part of the observed multiplicity spread is not due to the fundamental fluctuations in the emission of secondaries in a nucleon-nucleon collision, but to the randomness in the number of particles involved. For nucleon-nucleon interactions at about $5 \cdot 10^{12}$ ev, the fundamental fluctuations can be approximated by a Gaussian with a width $\sigma = 6.5$. (auth)

10303

SPURIOUS SCATTERING OF 6.2 Gev PROTONS IN NUCLEAR EMULSIONS. F. W. Fischer (Boeing Airplane Co., Seattle, Wash.) and J. J. Lord (Univ. of Washington, Seattle). Nuovo cimento (10) 11, 44-7 (1959) Jan. 1.

Multiple scattering measurements of 6.2 Bev proton tracks in emulsion were made for cell lengths up to 10,000 microns. It was found that the spurious scattering contribution remained constant for cell lengths greater than about 3000 microns. Measurements on a group of parallel tracks showed that the region of the microscopic dislocations responsible for spurious scattering had dimensions on the order of 1 to 2 mm. (auth)

10304

POSSIBLE EXPLANATION OF THE RADIATION OBSERVED BY VAN ALLEN AT HIGH ALTITUDES IN SATELLITES. P. J. Kellogg (Univ. of Minnesota, Minneapolis). Nuovo cimento (10) 11, 48-66 (1959) Jan. 1.

The possibility is considered that the radiation observed at high altitudes by Van Allen and co-workers is due to the decay electrons and protons from neutrons produced in the earth's atmosphere by cosmic rays and stored in the earth's magnetic field. Order of magnitude estimates for the densities to be expected are presented. Only scattering loss is considered. Using a lifetime of 3×10^3 s for loss through scattering, an upper limit of 10^{-2} electrons/cm³ near the earth and $0.05(R_E/r_0)^3$ electrons/cm³ at large distances r_0 in the equatorial plane is obtained. The proton density at large distances

is $0.03(R_E/r_0)^2 \text{ cm}^{-3}$, for a lifetime of 10^{12} s . If plasma accelerations are not important, then the spectrum of electrons will be that of neutron β decay. The protons are produced by fast neutrons coming directly from nuclear stars and their spectrum will be approximately that of the protons from stars. The electron density is sufficient to give a counting rate a few times larger than is observed, while the proton density is sufficient to give a counting rate 10^4 times higher than the observed lower limit. The lifetimes of stored particles are therefore probably much less than those given by scattering. There should be a strong latitude effect which is roughly estimated as proportional to $\cos^6 \lambda$. Reasons are given for believing that collective effects will reduce the density below this near the poles. (auth)

10305

ELASTIC DIFFERENTIAL CROSS-SECTION FOR 60 Mev K^+ -SCATTERING IN EMULSION. T. G. Lim and J. P. van der Linden (Univ. of Amsterdam). *Nuovo cimento* (10) **11**, 67-72(1959) Jan. 1.

By the method of the phase shift optical model analysis, the differential cross sections for 60-Mev K^+ mesons elastically scattered by complex nuclei in Ilford G-5 nuclear emulsion are computed. The calculations are based on the assumption that the elastic scattering is due to a symmetrical square well potential of +13 Mev, superposed on the Coulomb potential. The resultant emulsion cross section $d\sigma/d\omega = f(\theta)$ curve is obtained from the separate contributions of the cross sections for the K^+ -meson scattering by C, Ag, Br, and O. Previously the resultant cross sections were computed by Costa and Patergnani on the assumption that the K^+ mesons were scattered by the hypothetical elements $42E^{86}$ and $7E^{14}$, representing the average of the heavy and the light elements in the emulsion, respectively. It is found that the $d\sigma/d\omega = f(\theta)$ curves obtained by their method and by the present ones do not coincide but agree fairly well. (auth)

10306

THREE BODY FORCES IN HYPERNUCLEI. G. G. Bach (Univ. of Rome). *Nuovo cimento* (10) **11**, 73-86 (1959) Jan. 1.

An investigation is made to ascertain the relative importance of the two-body and three-body A-nucleon potentials which have the same order of coupling constant. The three-body potential, which is derived using perturbation theory from a pseudoscalar interaction, is found to be weakly singular and hence much smaller than the two-body potential. In addition, the largest terms are noncentral. In the hypertriton, where correlations are large, it is found that three-body forces are repulsive for S states and may amount to 4%. Suitable D state admixture could lead to a repulsive three-body force of nearly 6%. In heavy hypernuclei, the relative importance of three-body forces is about $1/2\%$ if correlations are neglected, and may be as large as $7 1/2\%$ if correlations are as strong as they are in the hypertriton. It is also found that by omitting the Feynman graphs with bare lines the three-body contributions are negligible. (auth)

10307

DETECTION OF HIGH ENERGY μ -MESONS BY AN AIR ČERENKOV COUNTER. R. Giacconi, W. Blum, and G. T. Reynolds (Princeton Univ., N. J.). *Nuovo cimento* (10) **11**, 102-7(1959) Jan. 1.

An investigation of the properties of air Cherenkov

counters is described. A quantitative interpretation of the results is given. (auth)

10308

ANGULAR MOMENTUM DISTRIBUTIONS FOR THE THOMAS-FERMI FIELD. T. Tietz (Univ. of Lodź, Poland). *Nuovo cimento* (10) **11**, 121-3(1959) Jan. 1.

A mathematical analysis was made for angular momentum distributions for the Thomas-Fermi field. A comparison of results with experimental investigations is tabulated. (A.C.)

10309

COMPOUND MODEL AND THE RELATIVE PARITY OF BARYONS. Y. Oishi. *Nuovo cimento* (10) **11**, 124-5(1959) Jan. 1.

The possibility of obtaining the structure of strong interactions is explored by assuming that all compound systems are S-state coupled and intrinsic parities are the products of the intrinsic parities of the component particles. Only compound models are investigated which consider Fermions as their basic particles. (A.C.)

10310

CROSS-SECTION AND POLARIZATION IN ELASTIC NUCLEON-DEUTERON SCATTERING. L. Castillejo (Univ. of Birmingham, Eng.) and L. S. Singh (University Coll., London). *Nuovo cimento* (10) **11**, 131-5(1959) Jan. 1.

Numerous investigations have shown that there is as yet no unique set of phase shifts to explain the nucleon-nucleon interaction at a given energy. The present investigation shows how far nucleon-deuteron cross sections and polarization will provide criteria for differentiating between the various sets of phase shifts. The results of phase shift analysis are graphically shown. (A.C.)

10311

ON THE SYMMETRIES CONCERNING THE SCHEME OF ELEMENTARY PARTICLES. N. Dallaporta (Univ. of Padua and Istituto Nazionale di Fisica Nucleare, Padua). *Nuovo cimento* (10) **11**, 142-8(1959) Jan. 1.

The study of strong interactions has been based up to now on the Lagrangian used by d'Espagnat and Prentki and Salam. Another kind of Lagrangian has been proposed by Pais. The relation between these two Lagrangians is the following: one can assume that fundamentally the baryons are all isospin doublets of equal mass so that the Pais expression is the fundamental interaction, and the coupling and interaction constants of the different terms are linked together by the fundamental symmetries which rule the scheme. However, Pais has shown that such an assumption appears now to be incompatible with the experimental data and has recently examined the possibility that the parities of charged K 's could be opposite to the parities of K^0 . Should the parity of charged and neutral K 's turn out to be effectively opposite, there would be no more objection to the assumption of direct $KK\pi$ interactions. (A.C.)

10312

ENERGY LOSS PER ION PAIR FOR PROTONS IN VARIOUS GASES. H. V. Larson (General Electric Co., Richland, Wash.). *Phys. Rev.* **112**, 1927-8(1958) Dec. 15.

Values of w for protons in Ar, N_2 , CO_2 , dry air, and "tissue-equivalent" gas were measured as 26.66 ± 0.26 ,

36.68 ± 0.34 , 34.37 ± 0.33 , 35.18 ± 0.42 , and 30.03 ± 0.29 ev/ion pair, respectively. A 2-Mev positive-ion accelerator was used as the source of protons. The energy of the protons was determined with a precision gaussmeter that was calibrated by the $\text{Li}(p,n)$ and $\text{T}(p,n)$ threshold reactions. These protons were scattered from a gold foil into a parallel plate ionization chamber. The fast-electron pulses were collected on one electrode, amplified, and counted. The positive-ion charge was collected on the other electrode and measured by means of a standard capacitor that was connected between the input and feedback terminals of a vibrating-reed electrometer. (auth)

10313

HELICITY OF THE ELECTRON AND POSITRON IN MUON DECAY. Pierre C. Macq, Kenneth M. Crowe, and Roy P. Haddock (Univ. of California, Berkeley). *Phys. Rev.* **112**, 2061-71(1958) Dec. 15.

The helicity of the electron and positron from muon decay was measured by determining the sense of circular polarization of their bremsstrahlung by the method of absorption in iron magnetized against or along the direction of motion of the particles. The positron is found to be right-handed and the electron left-handed. The results are consistent with the two-component neutrino theory, which assumes (V,A) interaction, conservation of leptons, and left-handed neutrinos. (auth)

10314

ELECTRON SCATTERING FROM THE DEUTERON AND THE NEUTRON-PROTON POTENTIAL. John A. McIntyre and George R. Burleson (Stanford Univ., Calif.). *Phys. Rev.* **112**, 2077-86(1958) Dec. 15.

Electron scattering by the deuteron was studied experimentally at 400 and 500 Mev. The results of the scattering are compared with the scattering expected by three different static deuteron models. All three models satisfy the usual deuteron requirements such as binding energy, effective range, quadrupole moment, and percent D state. Two of the models have Yukawa neutron-proton potentials; the third has a repulsive-core potential. The experimental results agree with the repulsive-core model and disagree with the Yukawa models. This result applies only to the triplet-S neutron-proton potential. (auth)

10315

ENERGY SPECTRUM OF π MESONS PRODUCED BY INTERACTION OF COSMIC RADIATION WITH EMULSION NUCLEI. Herman Yagoda (Air Force Cambridge Research Center, Bedford, Mass.). *Phys. Rev.* **112**, 2087-95(1958) Dec. 15.

An analysis of 958 π mesons ejected from stars which terminate their range in G5 emulsion exposed in the stratosphere shows a predominance of negative mesons. The average ratio from all emulsion interactions over a pion kinetic energy ≈ 45 Mev is $\pi^-/\pi^+ = 5.17 \pm 0.41$. Further study shows that this ratio varies with the charge of the target nuclei and is strongly dependent on the kinetic energy of the emitted mesons. By classifying the stars on the basis of the sum of the charges on the evaporation tracks a large fraction of the stars can be attributed to the disintegration of heavy (Ag-Br-I) or light (C-N-O) target nuclei. On this basis 537 pions originate from heavy nuclei and 297 from light nuclei. The residual group of 124 mesons arise from peripheral collisions with heavy or light target nuclei, interactions with hydrogen, photomeson production, and fun-

damental particle decay processes. The variation of the charge ratio with pion kinetic energy is evaluated for both the light and heavy emulsion nuclei and compared with the yield from targets of similar charge employed in cyclotron studies. The energy spectrum of the mesons produced by cosmic ray interactions on emulsion nuclei from 1.5 to 33 Mev shows good agreement with early Bristol measurements of shower particles originating from stars and with more recent studies of ejected mesons by the Russian group. The form of the differential energy spectrum appears to be largely independent of geomagnetic latitude and altitude of the exposure when the meson yield is expressed in units of particles per shower star per Mev. (auth)

10316

ELECTRON NUMBER DISTRIBUTION IN ELECTRON-PHOTON SHOWERS. J. C. Butcher and H. Messel (Univ. of Sydney). *Phys. Rev.* **112**, 2096-2106(1958) Dec. 15.

Numerical results for the number distribution of electrons above a given energy due to primary electrons and photons are given. The average numbers derived from the distributions are also given. Values are presented both for the case of approximation A and for more accurate cross sections at low energies in air. Collision losses and Compton effect are taken into account but scattering at low energies is neglected. The calculations were carried out using Monte Carlo methods on the electronic digital computer SILLIAC. The results of the calculations are discussed and compared with previous work on the subject. (auth)

10317

TWO-PAIR DECAY AND THE SPIN OF THE NEUTRAL PION. David W. Joseph (Univ. of Chicago). *Phys. Rev.* **112**, 2107-11(1958) Dec. 15.

The rare decay mode $\pi^0 \rightarrow$ two electron pairs is investigated as a possible means of directly measuring the π^0 spin; chief consideration is given to the case of spin 2, since the occurrence of the two-photon decay requires the spin to be 0 or ≥ 2 . If the angle between the planes of the two pairs is denoted by ϕ , the distribution in ϕ is proportional to $(1 + \lambda \cos 2\phi)$. For spin 2^+ , λ is calculated to be $+0.001$, while for 2^- , only the restriction $-0.19 < \lambda < 0$ is found; this is to be compared with the values for spins 0^{\pm} (previously calculated by Kroll and Wada) of ± 0.19 . The rate of occurrence of events in which the two pairs share the energy quite unequally is also calculated. It is found that a small value of $|\lambda|$ for spin 2^- should be accompanied by a value of this rate and of the ratio $(\pi^0 \rightarrow 4e)/(\pi^0 \rightarrow 2\gamma)$ both considerably greater than for spins 0^{\pm} , while for large $|\lambda|$ or for spin 2^+ these quantities should be close to the spin 0^{\pm} values. (auth)

10318

K_{e3} AND $K_{\mu 3}$ DECAY MODES. M. Sugawara (Purdue Univ., Lafayette, Ind.). *Phys. Rev.* **112**, 2128(1958) Dec. 15.

A viewpoint is presented in which some boson pairs are included among members which are exerting universal weak interactions on each other. The inclusion of K-meson-pion pairs leads to direct terms responsible for K_{e3} and $K_{\mu 3}$ decay modes. It is shown that these direct terms may result in too rapid decays of K_{e3} and $K_{\mu 3}$ if one assumes the universality of the weak-coupling constant, while the branching ratio of these decay modes is quite consistent with the data. (auth)

10319

CHARGE PROPERTIES OF THE K MESON AND HYPERON DECAY INTERACTION. R. F. Sawyer (CERN, Geneva). Phys. Rev. **112**, 2135-8(1958) Dec. 15.

The question of the ΔT involved in strange-particle decays is discussed in terms of universal Fermi interactions. The fundamental interactions considered contain $\Delta T > \frac{1}{2}$ as suggested by both experimental and purely theoretical considerations. It is found that by assuming global symmetry in both the pion coupling and the weak coupling one may restrict the ΔT to $\frac{1}{2}$ in a class of processes involved in hyperon decay. These are the processes in which the real pion is given off externally. A symmetry may also be incorporated which forbids the decay $\Xi^- \rightarrow N + \pi$. A breakdown of this symmetry is necessary to allow Σ^- decay. Reasons are developed for this breakdown to be manifested primarily in the P-wave part of Σ and Λ decay. A consequence is that Σ^- decay should allow no parity nonconservation. The assumption of global symmetry enables one to connect Σ decay to Λ decay. Fitting the decay rates in the suggested model yields a prediction of the Λ decay rate and asymmetry in agreement with experiment. Various ways of obtaining a selection rule prohibiting the θ^+ mode of K decay are discussed. These depend on symmetries which may be incorporated into an interaction containing $\Delta T = \frac{1}{4}, \frac{3}{2},$ and $\frac{5}{2}$. (auth)

10320

FREE ANTINEUTRINO ABSORPTION CROSS SECTION. I. MEASUREMENT OF THE FREE ANTINEUTRINO ABSORPTION CROSS SECTION BY PROTONS. Frederick Reines and Clyde L. Cowan, Jr. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. **113**, 273-9(1959) Jan. 1.

The cross section for the reaction $p(\bar{\nu}, \beta^+)n$ was measured using antineutrinos ($\bar{\nu}$) from a powerful fission reactor at the Savannah River Plant of the United States Atomic Energy Commission. Target protons were provided by a 1.4×10^3 liter liquid scintillation detector in which the scintillator solution (triethylbenzene, terphenyl, and POPOP) was loaded with a cadmium compound (cadmium octoate) to allow the detection of the reaction by means of the delayed coincidence technique. The first pulse of the pair was caused by the slowing down and annihilation of the positron (β^+), the second by the capture of the neutron (n) in cadmium following its moderation by the scintillator protons. A second giant scintillation detector without cadmium loading was used above the first to provide an anticoincidence signal against events induced by cosmic rays. The antineutrino signal was related to the reactor by means of runs taken while the reactor was on and off. Reactor radiations other than antineutrinos were ruled out as the cause of the signal by a differential shielding experiment. The signal rate was 36 ± 4 events/hr and the signal-to-noise ratio was $\frac{1}{2}$, where half the noise was correlated and cosmic-ray associated and about half was due to non-reactor-associated accidental coincidences. The cross section per fission $\bar{\nu}$ (assuming 6.1 $\bar{\nu}$ per fission) for the inverse beta decay of the proton was measured to be $(11 \pm 2.6) \times 10^{-44}$ cm²/ $\bar{\nu}$ or $(6.7 \pm 1.5) \times 10^{-43}$ cm²/fission. These values are consistent with prediction based on the two-component theory of the neutrino. (auth)

10321

FREE ANTINEUTRINO ABSORPTION CROSS SECTION. II. EXPECTED CROSS SECTION FROM MEAS-

UREMENTS OF FISSION FRAGMENT ELECTRON SPECTRUM. R. E. Carter, F. Reines, J. J. Wagner, and M. E. Wyman (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. **113**, 280-6(1959) Jan. 1.

A measurement of the electron spectrum from the thermal neutron fission of U²³⁵ is described. From this spectrum the antineutrino spectrum is calculated, and on the basis of the two-component theory of the antineutrino a predicted average cross section for the absorption of antineutrinos by protons is $(6.1 \pm 1) \times 10^{-43}$ cm²/fission. This agrees with the measured cross section of $(6.7 \pm 1.5) \times 10^{-43}$ cm²/fission. The four-component theory of the antineutrino would have predicted $(3.05 \pm 0.5) \times 10^{-43}$ cm²/fission. (auth)

10322

PROTON-PROTON SCATTERING AT 19.8 Mev. Jack W. Burkig, J. Reginald Richardson, and Glen E. Schrank (Univ. of California, Los Angeles). Phys. Rev. **113**, 290-3(1959) Jan. 1.

An experimental measurement of the angular distribution of the scattering of 19.8-Mev protons by protons is described. The scattering material was hydrogen gas and detection was by scintillation counters. The cross section as a function of center-of-mass scattering angle reveals a minimum at 26° where $d\sigma/d\omega = 22.6 \pm 0.3$ mb/steradian. The measurements range from 14° where $d\sigma/d\omega = 59.7 \pm 2.0$ mb/steradian to 90° where $d\sigma/d\omega = 24.6 \pm 0.3$ mb/steradian and include measurements at 15 angles. The phase-shift analysis of the data is as yet incomplete. (auth)

10323

SMALL-ANGLE PROTON-PROTON SCATTERING AT 20 Mev. Herbert N. Royden and Byron T. Wright (Univ. of California, Los Angeles). Phys. Rev. **113**, 294-6(1959) Jan. 1.

The differential cross section for the scattering of 19.8-Mev protons by protons was measured for angles between 18 and 35° in the center-of-mass system, detection being by photographic emulsion placed in a scattering camera. Cross sections were measured simultaneously at all angles and azimuths. A run with analyzing slits closed served to evaluate the small slit-edge correction. The accuracy of the cross section measurements is approximately 2.5% at all angles except 18°, where the accuracy is about 3%. (auth)

10324

COSMIC-RAY LATITUDE SURVEY ALONG 145° EAST LONGITUDE USING AN AIRBORNE NEUTRON MONITOR. J. R. Storey (Univ. of Tasmania, Hobart). Phys. Rev. **113**, 297-301(1959) Jan. 1.

An account is given of a survey of the cosmic-ray nucleonic component along the 145° east longitude between geographic latitudes 34°N (Tokyo) and 52°S. The instrument used was a Simpson-type neutron monitor installed in a Lincoln bomber and measurements were made at a pressure altitude of 20,000 ft (475 g cm⁻²). A check on the equipment performance was provided by covering the entire route twice. A Forbush-type intensity decrease was encountered during the southbound section between latitudes 5°S and 36°S. The cosmic-ray equator was located at 7.1°N geographic (2.4°S geomagnetic) and the south cosmic-ray knee, defined as the latitude south of which there is no further increase of intensity with latitude, occurred at 43.5°S geographic (52.3°S geomagnetic). The survey north of Melbourne (38°S geographic) was completed

between July 18 and August 6, 1957. Flights south from Melbourne were made on August 19 and 21, 1957. (auth)

10325

LATITUDE DEPENDENCE OF A FORBUSH-TYPE COSMIC-RAY INTENSITY DECREASE OBSERVED AT AIRCRAFT ALTITUDE. J. R. Storey (Univ. of Tasmania, Hobart). *Phys. Rev.* **113**, 302-4(1959) Jan. 1.

During the aerial survey of the cosmic-ray nucleonic component along the longitude 145°E described in the previous paper, two southbound flights between geographic latitudes 5°S and 36°S were made under depressed cosmic-ray intensity following the Forbush-type decrease commencing August 4, 1957. Comparison of the intensity vs. latitude plot with that obtained during the northbound flights over the same route when quiet cosmic-ray conditions prevailed enabled the latitude dependence of the decrease to be determined. It is found that for the event investigated, the percentage decrease was independent of latitude over the range 5°S to 36°S geographic (14°S to 45°S geomagnetic) at the altitude of observation (475 g cm⁻²). However, comparison of data from two fixed stations, Lae (16°S geomagnetic) and Hobart (52°S geomagnetic), showed that this latitude independence did not extend to sea level. (auth)

10326

PHOTOPRODUCTION OF PION PAIRS IN HYDROGEN. Michel Bloch and Matthew Sands (California Inst. of Tech., Pasadena). *Phys. Rev.* **113**, 305-15(1959) Jan. 1.

The photoproduction of pion pairs was observed by detecting, in a magnetic spectrometer, the negative pions which emerged at 60° and at 120° from a hydrogen target in the bremsstrahlung beam of an electron synchrotron. The yields of negative pions "per equivalent quantum" were measured for several values of the pion energy and the bremsstrahlung cutoff energy. From the variations of the yields with bremsstrahlung cutoff energy, the cross section for the emission of negative pions was obtained. The cross section shows no large dependence on the pion angle from 90° to 150° in the c.m. system. The integral of the cross section over the negative pion energy is consistent with a constant value of about 4×10^{-30} cm²/sterad for photon energies between 600 and 1100 Mev. The observed dependence of the cross section on pion energy was compared to some phenomenological models. (auth)

10327

"ANOMALOUS" SCATTERING OF μ MESONS. Shuji Fukui (Osaka Univ.) and Takashi Kitamura and Yuzuru Watake (Osaka City Univ.). *Phys. Rev.* **113**, 315-24 (1959) Jan. 1.

A μ -meson scattering experiment in which the mesons are required to traverse a thick block of iron and stop and decay in a thin layer of carbon, is reported. Any uncertainty in the identity of the scattered particle has thus been eliminated, and further, the momentum of the particles is well defined. The observed angular distribution of the scattered μ mesons in the momentum range (1_{-0.2}^{+0.15}) BeV/c was found to be in good agreement with the distribution predicted from the Coulomb scattering theory for extended nuclei obtained by Cooper and Rainwater. There is thus no indication from the present experiment for any anomalous scattering of μ mesons near 1 BeV/c momentum. The angular distribution of scattering of those particles which traversed the iron absorber but did not necessarily stop and decay in

the carbon layer was not in good agreement with the Cooper and Rainwater theory, there being more than the expected number of particles scattered through large angles. It is shown, however, that the predicted scattering distribution, at large angles (assuming no anomalous contribution) arises almost entirely from the scattering of particles in the 1-2 BeV/c region, and therefore is very sensitive to the assumed intensity in this region. It is concluded that the results from this part of the experiment cannot be accepted as evidence favoring the existence of anomalous scattering. The experimental results of other authors on the scattering of energetic μ mesons are summarized and discussed. It is concluded that the evidence for anomalous interactions is not strong. (auth)

10328

ELASTIC PROTON-PROTON COLLISIONS AT 6.2 BeV IN NUCLEAR EMULSIONS. R. M. Kalbach, J. J. Lord, and C. H. Tsao (Univ. of Washington, Seattle). *Phys. Rev.* **113**, 325-9(1959) Jan. 1.

Iford G-5 emulsions were exposed to the 6.2-BeV proton beam of the Berkeley Bevatron. Of the interactions located, 31 could be classified as elastic collisions of beam protons with free, hydrogen nuclei. After correction for scanning efficiency and background events, an elastic scattering cross section of 8.8 ± 2.0 mb was obtained. The center-of-mass system angular distribution of elastically scattered protons is sharply peaked in the forward and backward direction and is in fair agreement with the prediction of a uniform optical model with a radius of 0.94×10^{-13} cm, a phase shift of 0.00 radian, and an opacity of 0.81. The results are compared with those of previous experiments. (auth)

10329

INELASTIC PROTON-PROTON COLLISIONS AT 6.2 BeV. R. M. Kalbach, J. J. Lord, and C. H. Tsao (Univ. of Washington, Seattle). *Phys. Rev.* **113**, 330-7(1959) Jan. 1.

Inelastic, 6.2-BeV proton-proton collisions in nuclear emulsions are examined using the internal beam of the Berkeley Bevatron. Multiple scattering, grain density, range, and angle measurements yield the momentum spectra and angular distributions of secondary pions and protons together with the cross sections for accessible final states. The results indicate a cross section of 7.3 ± 4.6 mb for two prong events, 12.1 ± 2.4 mb for four prong events, 2.7 ± 0.6 mb for six prong events, 0.3 ± 0.3 mb for eight prong events, and 0.2 ± 0.2 mb for ten prong events, giving a total inelastic cross section of 22.6 ± 5.3 mb. The average charged pion multiplicity was found to be 1.9 ± 0.3 and the value of K, the average degree of inelasticity, 0.49 ± 0.05 . Comparison of observed partial inelastic cross sections with the predictions of the Fermi statistical theory indicates that this theory underestimates the relative probability for states with high meson multiplicity. Considerable forward and backward peaking was observed in the center-of-mass system angular distributions for secondary protons and, to a lesser extent, for secondary charged pions. Center-of-mass system momentum distributions for secondary charged pions peak at lower momenta than predicted by the statistical theory, while those for protons peak somewhat higher than predicted. Effects are discussed which could account for these discrepancies. (auth)

10330

HIGH-ENERGY MAXIMA IN THE π -p CROSS SECTIONS. Robert K. Adair (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **113**, 338-41(1959) Jan. 1.

It is pointed out that the consideration of causality requires that any description of the maximum in the π^- -p total cross section at 800-Mev π^- energy, and the maximum in the π^+ -p cross section at 1200-Mev, is necessarily equivalent to a description in terms of resonances and hence in terms of nucleon isobars. (auth)

10331

PRELIMINARY RESULTS ON THE MOMENTUM DEPENDENCE OF THE ASYMMETRY IN MUON DECAy. Hans Kruger and Kenneth M. Crowe (Univ. of California, Berkeley). *Phys. Rev.* **113**, 341-3(1959) Jan. 1.

Positive muons from the Berkeley 184-in. synchrocyclotron were stopped in various materials and the asymmetry of positrons from their decay was determined by using a magnetic spectrometer method. The measurements of the polarization are in agreement with that predicted by the two-component neutrino theory. The product of the muon beam polarization and of ξ , the parameter of the two-component neutrino theory, was measured as 0.89 ± 0.09 . (auth)

10332

VARIATIONS IN THE COSMIC-RAY RIGIDITY SPECTRUM. K. G. McCracken (Univ. of Tasmania, Hobart). *Phys. Rev.* **113**, 343-8(1959) Jan. 1.

Variations in the counting rates of two different high-latitude neutron monitors, a high-latitude meson telescope, and a low-latitude neutron monitor are studied for the period August 1956, to January 1958. A long-term decrease in counting rate was observed at all stations, superposed on which there were numerous short-term variations of from 3 to 30 days duration. The long-term variation in neutron counting rate at high latitudes was four times greater than that at low latitudes, indicating that the change in the cosmic-ray spectrum was most pronounced at low rigidities. The high-latitude short-term variations in neutron counting rate were about 2.5 times greater than those at low latitudes, the ratio varying from event to event. This is interpreted as evidence that the spectrum changes during short-term variations are less strongly dependent upon rigidity than in the case of the long-term variation, and that they are of a variable character. Comparison of the neutron data with simultaneous meson data supports this view. It is concluded that the long- and short-term variations in intensity are produced by different mechanisms. (auth)

10333

HYPERON-ANTIHYPHERON PRODUCTION IN NUCLEON-ANTINUCLEON COLLISIONS AND THE RELATIVE E - Λ PARITY. Saul Barshay (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **113**, 349-51(1959) Jan. 1.

A discussion is given of hyperon-antihyperon production in nucleon-antinucleon collisions near threshold. The rate for the reaction and the polarization of the outgoing baryons are calculated in terms of three amplitudes characterizing the transition operators in the two cases of even and odd relative E - Λ parity. In terms of these amplitudes, a correlation function which gives the angular correlations between the pion momenta

from the subsequent decay of the hyperon and antihyperon, and the vectors involved in the production process, is given for each relative parity. The possibility of this class of experiments being useful in determining the relative Σ^0 - Λ parity, as well as the relative charged Σ - Λ parity, is discussed. (auth)

10334

PION SPECTRUM IN RADIATIVE K_π^+ DECAY. J. D. Good (Univ. of Chicago). *Phys. Rev.* **113**, 352-5(1959) Jan. 1.

The π^+ energy spectrum is calculated for the process $K^+ \rightarrow \pi^+ + \pi^0 + \gamma$, taking into account the processes of internal bremsstrahlung and of direct dipole emission, both E1 and M1 transitions being permitted with parity nonconservation for weak decays. For the π^+ energy range 55-75 Mev, which has been examined in some recent investigations, the internal bremsstrahlung process alone leads to an expectation of 1.0 anomalous K_π^+ decay in the 8653 K^+ decays examined, quite compatible with the observation of two anomalous K_π^+ decays in these data. For reasonable values of the dimensionless parameters $A(\mu/M)^4$ and $B(\mu/M)^4$ which specify the dipole transition strengths, (that is, with $A = B = 1$ and M equal to the K -particle mass), it appears that their main contribution will arise from the interference of the E1 direct transition with the internal bremsstrahlung term, increasing or decreasing the above estimate by about 20%. (auth)

10335

Ξ^- CAPTURE REACTIONS IN HYDROGEN. S. B. Treiman (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **113**, 355-7(1959) Jan. 1.

In the capture reaction $\Xi^- + p \rightarrow \Lambda + \Lambda$, the asymmetries in the Λ decays constitute an excellent analyzer for determining the polarization pattern of the Λ 's and hence the nature of the final orbital states involved. Such information, together with evidence concerning alternate capture channels $\Xi^- + p \rightarrow \Xi^0 + n$, $\Xi^- + p \rightarrow \Lambda + \Lambda + \gamma$, may permit a determination of the parity of Ξ relative to that of the nucleon. (auth)

10336

PROOF OF DISPERSION RELATIONS FOR THE PRODUCTION OF PIONS BY REAL AND VIRTUAL PHOTONS AND FOR RELATED PROCESSES. Reinhard Oehme (Univ. of Chicago) and John G. Taylor (Univ. of Maryland, College Park). *Phys. Rev.* **113**, 371-80(1959) Jan. 1.

It is shown that the amplitudes for the production of pions by photons and electrons (virtual photons), as well as for elastic photon-proton and photon-deuteron scattering, have certain analytic properties as functions of energy and momentum transfer. These properties are proven on the basis of the axioms of field theory, especially local commutativity and the spectral conditions. They guarantee the validity of the usual dispersion relations for restricted values of the invariant momentum transfer. In the construction of these dispersion formulas the electromagnetic interaction is treated in lowest order. The residues of the poles arising from the single-particle intermediate states are related to the corresponding vertex functions. For fixed values of the total energy the absorptive parts of the amplitudes are analytic functions of momentum transfer; they are regular inside certain ellipses. These properties make it possible to continue the absorptive parts into the "unphysical region" appearing in the

nonforward dispersion relations by means of partial-wave expansions. A brief survey is given of the limitations in momentum transfer or the unphysical mass restrictions, which one encounters in the proof of dispersion relations for some elastic scattering processes. (auth)

10337

NUCLEON-ANTINUCLEON SCATTERING. James S. Ball and Jose R. Fulco (Univ. of California, Berkeley). *Phys. Rev.* **113**, 647-50(1959) Jan. 15.

By use of the model of the nucleon-antinucleon interaction proposed by Ball and Chew, a calculation of the complex phase shifts at 50 and 260 Mev was made. The values of annihilation, elastic-scattering, and charge-exchange cross sections, and the angular distributions for \bar{p} - p and \bar{p} - n elastic scattering are obtained. A comparison with the experimental data shows reasonable agreement. The parameters of an optical-model potential for antinucleon interaction with complex nuclei are presented. (auth)

10338

p - n ASYMMETRIES AT 143 Mev. Stuart G. Carpenter and Richard Wilson (Harvard Univ., Cambridge, Mass.). *Phys. Rev.* **113**, 650-3(1959) Jan. 15.

The asymmetry of neutrons produced by bombardment of C, Al, Cu, and Pb by 143-Mev polarized protons, at angles 20° to 70° , was measured. The asymmetry is almost independent of target element but is inconsistent with that from a free p - n collision. The mechanism for the process is discussed. (auth)

10339

μ -MESON DECAY WITH INNER BREMSSTRAHLUNG. C. Fronsdaal and H. Überall (CERN, Geneva). *Phys. Rev.* **113**, 654-7(1959) Jan. 15.

The differential transition probability for the radiative decay of a polarized μ meson with the most general choice of coupling constants, is calculated and integrated over electron energies. The extent to which this process may be useful for determining the coupling constants is discussed. (auth)

10340

IONIZATION LOSS BY μ MESONS IN HELIUM. Robert E. Lanou, Jr. and Henry L. Kraybill (Yale Univ., New Haven). *Phys. Rev.* **113**, 657-61(1959) Jan. 15.

The ionization loss by cosmic-ray μ mesons in helium gas was measured as a function of momentum. The ionization loss was determined with proportional counters and the momenta were measured by a magnetic spectrometer which resolved particles in the momentum region from 3.3 Bev/c to 140 Bev/c. It was found that helium gas at 2.7-atmospheres pressure exhibits a density-effect saturation of the most probable ionization loss and that this saturation is complete at a $p/\mu c$ value of about 200. Under the conditions of normalization used in this experiment, the value of the ionization loss at which the Fermi plateau occurs is 1.28 ± 0.04 times the value at the minimum. This is in agreement with calculations based on the Sternheimer theory for the particular counter filling used in this experiment. (auth)

10341

CAPTURE AND DECAY OF μ -MESONS IN Fe. W. A. Barrett, F. E. Holmstrom, and J. W. Keuffel (Univ. of Utah, Salt Lake City). *Phys. Rev.* **113**, 661-5(1959) Jan. 15.

The mean life of μ^- mesons in Fe was measured using an improved cosmic-ray apparatus. A positive identification of the stopped muon was made using Cherenkov velocity selectors in the incident telescope. The 2.2- μ sec background from positive muons was reduced by a factor of 3 with a 3-layer sandwich of Fe and thin plastic scintillators, so arranged that electrons emitted in the target were mostly detected as such by the scintillators. The mean life is $196 \pm 8 \mu$ sec. By comparing this result with the electron-counting results of Lederman and Weinrich, the ratio of the decay rate of μ^- bound in Fe to the free μ^- -decay rate is found to be 1.15 ± 0.06 . (auth)

10342

RADIATIVE CAPTURE OF K^- MESONS FROM ORBITAL P STATES OF K-MESONIC ATOMS. Graham Frye (Univ. of California, Berkeley). *Phys. Rev.* **113**, 688-9(1959) Jan. 15.

The photon spectrum accompanying the radiative capture of K^- mesons from orbital P states of K-mesonic hydrogen atoms is discussed. (auth)

10343

EVIDENCE AGAINST THE MASS-500 PARTICLE. E. Bierman, R. Lea, J. Orear, and S. Rosendorff (Columbia Univ., New York). *Phys. Rev.* **113**, 710-12(1959) Jan. 15.

The existence of a mass-500 particle was investigated by exposing a nuclear emulsion to cosmic rays at an altitude of 10,600 feet and geomagnetic latitude 39° . Particles of average range, 60 g/cm² of copper, were stopped in the emulsion and grain counted at a residual range of 1 cm. The available track length was such that the existence of a mass-500 particle would have been established on the basis of a single occurrence. About 1100 muons were found with no particles in the region of 500 electron masses being observed. This is not consistent with the abundance reported by Alikhanian et al., since the probability of finding none, assuming their reported abundance, is 0.4%. (auth)

10344

STRUCTURE OF THE NEUTRON. Katsumi Tanaka (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **113**, 714-25(1959) Jan. 15.

In an earlier paper, the contribution of the meson current to the electromagnetic structure of the nucleon was calculated by use of the dispersion relations for pion-nucleon scattering. Here the contribution of the nucleon current to the electromagnetic structure of the neutron is obtained analogously by use of the dispersion relations for neutron-proton scattering. Only the contribution from the one-pion and two-pion states of nucleon-nucleon scattering is considered. It is found that both states reduce the neutron-electron potential, i.e., leads to a smaller charge radius of the neutron. The contribution from the deuteron state is shown to be negligible. The resulting mean-square radii of the neutron, including the contributions of both meson and nucleon current, are $(0.23 \times 10^{-13} \text{ cm})^2$ for the charge distribution and $(0.41 \times 10^{-13} \text{ cm})^2$ for the magnetic moment distribution with $f^2 = 0.08$. (auth)

10345

RADIATIVE CORRECTIONS FOR NEARLY ELASTIC SCATTERING. E. L. Lomon (Cornell Univ., Ithaca, N. Y.). *Phys. Rev.* **113**, 726-7(1959) Jan. 15.

The treatment of large infrared contributions to electron scattering is discussed. An expression is

given for any energy resolution, yielding a previously conjectured form in the limit of perfect resolution. (auth)

10346

RADIATIVE MESON-NUCLEON SCATTERING. II. R. E. Cutkosky (Carnegie Inst. of Tech., Pittsburgh). *Phys. Rev.* **113**, 727-31(1959) Jan. 15.

A discussion is given of the corrections which must be made to the results of a previous calculation of radiative meson-nucleon scattering, in which the fixed-source model was used. Curves are given which show the spectrum and angular distribution of gamma rays emitted when positive mesons of energies 130, 175, and 220 Mev are scattered by protons. (auth)

10347

HIGHER ELECTROMAGNETIC CORRECTIONS TO ELECTRON-PROTON SCATTERING. S. D. Drell and S. Fubini (Stanford Univ., Calif. and CERN, Geneva). *Phys. Rev.* **113**, 741-4(1959) Jan. 15.

Higher order electromagnetic corrections to the electron-proton scattering amplitudes are studied. The scattering amplitude is subjected to a dispersion analysis which permits the e^4 contribution to be written as the sum of two terms. The first corresponds to radiative corrections to the form factors, the second to virtual photon Compton scattering by the proton. A simple model is constructed for the resonant contribution to Compton scattering which is shown to correct the form factor analysis negligibly up to ~ 1 Bev for all scattering angles. (auth)

10348

COSMIC-RAY STUDIES BY MEANS OF ARTIFICIAL EARTH SATELLITES. N. A. Dobrotin (Lebedev Inst. of Physics, Academy of Sciences, USSR). *Priroda* **48**, No. 1, 57-64(1959) Jan. (In Russian)

The data obtained from instruments installed in artificial satellites produced important information on the cosmic-ray primary emissions and the characteristics of the earth's magnetic field. The discovery of the new phenomenon of the intensive "aureole" of particles around the earth is of great significance. The cosmic-ray intensity variations in relation to distance from the earth and the relation of the particle number to geomagnetic latitude, as well as the cosmic-ray recordings of two counters in the second satellite, are plotted. A graph showing the gas discharge counter performance in equatorial regions at various elevations is included. (R.V.J.)

10349

THE EFFECT OF CARBON ABSORBERS ON THE NEUTRON PRODUCTION IN LEAD BY COSMIC RADIATION AND THE ABSOLUTE FREQUENCY OF NUCLEAR CASCADES IN LEAD LAYERS OF VARIOUS THICKNESSES. P. K. Sen Chaudhury and G. Pfozter (Max-Planck-Institut für Aeronomie, Lindau a. Harz, Ger.). *Z. Naturforsch.* **14a**, 10-23(1959) Jan. (In German)

The star frequency transition maxima in photographic emulsions have been measured by various authors. An investigation was made to correlate these transition maxima with transition effects in local neutron production. It was shown that a very definite maximum of the neutron counting rate, which appeared also as a maximum of the star frequency under 9 to 11 cm of carbon, could be traced back completely to the scattering of the evaporation neutrons in the absorber. A real increase of the neutron production was not detectable within 5%.

The intensity of the neutrons decreases with the layer thickness, corresponding to an absorber thickness of 182.30 g/cm². In contrast the dependence of the integral frequency of nuclear cascades in lead layers of various thicknesses shows characteristic traits which indicate a real connection with the transition effects which were detected in nuclear trace plates as maxima of the differential measured star frequency. By counting the neutron coincidences the interference background in the investigations with carbon absorbers was reduced decisively. The simultaneous counting of single neutrons and coincidences explained an absolute determination of the cascade number in lead without special calibration of the counter. The absolute intensity of the nuclear active component of the cosmic radiation determined by this method agreed with previous results. (tr-auth)

10350

PERMITTED AND FORBIDDEN REGIONS IN THE MOTION OF ELECTRICALLY CHARGED PARTICLES IN AXIAL-SYMMETRIC MAGNETIC FIELDS. H. Fisser and R. Kippenhahn (Max-Planck-Institut für Physik und Astrophysik, München). *Z. Naturforsch.* **14a**, 37-46(1959) Jan. (In German)

The trajectory of a charged particle in a magnetic field of rotational symmetry can be characterized by two integrals of motion: the kinetic energy I_2^2 and the generalized angular momentum I_1 . Orbits with different values of I_1 and I_2 correspond to different points in the I_1 - I_2 -plane. By the aid of this I_1 - I_2 -diagram a survey of the allowed and forbidden regions in the meridional plane are easily obtained. In another diagram the boundaries of these regions are transformed into straight lines. Both methods are applied to the field of a magnetic dipole and to that of a circular line-current. By the example of the circular current it is shown how the problem of the so-called particle-loss can be attacked. (auth)

10351

THE MOTION OF CHARGED PARTICLES IN THE MAGNETIC FIELD OF A STRAIGHT LIVE WIRE. F. Hertweck (Max-Planck-Institut für Physik und Astrophysik, München). *Z. Naturforsch.* **14a**, 47-54(1959) Jan. (In German)

The motion of a charged particle in the magnetic field of a straight electric line current of infinite length is investigated. Using the numerical solutions of the equations of motion the drift velocity of the particle along the wire is calculated. For small particle energies it turns out to be in agreement with Alfvén's approximation. Also the limits of the region to which the particle is confined are calculated for different values of the particle energy and its angular momentum. (auth)

10352

THEORY OF SMALL ANGLE SCATTERING OF X RADIATION AND NEUTRONS BY INTERNAL POTENTIALS IN SOLID BODIES, ESPECIALLY BY DISPLACEMENT. Alfred Seeger and Ekkehart Kröner (Technischen Hochschule und Max-Planck-Institut für Metallforschung, Stuttgart). *Z. Naturforsch.* **14a**, 74-80(1959) Jan. (In German)

The small-angle scattering caused by dislocations, which till now had to be ascertained as the integral over the expansion fields of the displacements (and other faults), is described (so far as it is treated ac-

cording to the linear elasticity theory) as an integral over the displacement density. For displacement lines (so-called singular displacements) this integral is reduced to a line integral extending along the displacement line. With the help of the line integral the calculations on the small angle scattering by displacements were simplified. As an example, the small-angle scattering by circular step displacement rings was treated. Such rings originate through the condensation of holes in crystals and play a roll in the discussion of processes in quenched metals. (tr-auth)

10353

IONIZATION MEASUREMENTS IN H_2 ON POSITRONS AND NEGATRONS OF 250 kev WITH A CLOUD CHAMBER. Lothar Wiedecke (Univ. of Kiel). *Z. Physik* **154**, 150-9(1959). (In German)

With a hydrogen-filled cloud chamber, a comparison of the ionization of positrons and negatrons in the energy range between 236 and 267 kev was made with the same conditions for both particles (average energy and energy distribution of the particle groups and supersaturation in the chamber). The measurements showed no variation between the two particles either for the primary ionization or for the practical ionization (average ionization). The value of the primary ionization corrected to hydrogen in normal conditions was in good agreement with the results of previous workers. By an extension of the Kunze method, a formula was derived for the correction of the common overlapping of drop formations. For a comparison of the measured practical ionization with the theoretical results, it is necessary to know the number of "drop clusters" simulated by statistical fluctuations of the ionization. A method was drafted for the estimation of this number. The method was applied to various cases. (tr-auth)

10354

INVESTIGATION OF THE NATURE AND SPECTRA OF PARTICLES PRODUCED BY HIGH ENERGY NUCLEONS. A. I. Alikhanov, G. P. Eliseev, V. Sh. Kamalyan, V. A. Lubimov, B. N. Moiseev, and A. V. Khrimyan. *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 404-10 (1959) Feb. (In Russian)

The nature and momentum spectra of secondary particles created in lead by high-energy cosmic-ray particles were investigated at an altitude of 3250 m above sea level with aid of a magnetic mass spectrometer and multi-layer proportional counter. (auth)

10355

SCATTERING OF μ -MESONS WITH MOMENTA OF ABOUT 100 Mev/c IN COPPER AND IRON. V. G. Kirillov-Ugryumov, B. A. Dolgoshein, A. M. Moskvichov, and L. P. Morozova (Moscow Inst. of Engineering Physics). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 416-23 (1959) Feb. (In Russian)

Scattering of μ mesons was investigated in copper plates (in the μ -meson momentum interval from 85 to 144 Mev/c) and in iron plates (μ -meson momenta from 81.2 to 135 Mev/c). The μ -meson angular distribution plotted on the basis of 2350 scattering events satisfactorily agrees with the distribution for a point nucleus. (auth)

10356

INVESTIGATION OF $\pi^+ - \mu^+ - e^+$ DECAY WITH HELP OF A PROPANE BUBBLE CHAMBER AND SCINTILLATION COUNTERS. M. P. Balandin, V. A. Moiseenko,

A. I. Mukhin, and S. Z. Otvinovskii (Joint Inst. of Nuclear Research, Dubna, U.S.S.R.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 424-32(1959) Feb. (In Russian)

It was found that the angular distribution of the μ^+ mesons is isotropic, whereas the positron angular distribution, if described by the expression $(1/4\pi)(1 - a \cos \theta)$, is characterized by the quantity $a = 0.116 \pm 0.035$. This value for a is much smaller than the values obtained in other works in which propane bubble chambers were employed. Scintillation counter experiments carried out with the purpose of ascertaining the cause of this discrepancy showed that the magnitude of the anisotropy significantly depends on the degree of purification of the commercial propane which is sometimes employed in bubble chambers. A simultaneous analysis of the data obtained with propane of a given composition with aid of a bubble chamber and scintillation counters showed that the quantity $\lambda(1 - W_C)$ is equal to 0.78 ± 0.26 where W_C is the probability for depolarization of μ^+ mesons in graphite and λ is a fundamental parameter in neutrino theory. (auth)

10357

ON POSSIBLE SETS OF EXPERIMENTS FOR A SIMULTANEOUS ANALYSIS OF DATA ON NUCLEON-NUCLEON SCATTERING AND POLARIZATION IN P-N COLLISIONS AT 635 Mev. B. M. Golovin, V. P. Dzhelepov, V. S. Nadezhdin, and V. I. Satarov (Joint Inst. of Nuclear Research, Dubna, U.S.S.R.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 433-43(1959) Feb. (In Russian)

It is suggested that an analysis of data on n-p and p-p scattering be carried out simultaneously as this should reduce the number of experiments required to reconstruct the scattering amplitude. Sets of experiments are presented which should yield sufficient information if the aforementioned analysis is performed. The angular dependence of the polarization in p-n collisions at 635 Mev was measured. A difference was detected in the energy and angular dependences of the polarization for states of a nucleon-nucleon system possessing different isotopic spins ($T = 0$ and $T = 1$). (auth)

10358

ON SOME CASES OF ELASTIC SCATTERING OF $\pi^+ - \mu^+ - e^+$ DECAY POSITRONS ON EMULSION ELECTRONS. Z. V. Minervina and E. A. Pesotskaya. *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 444-6(1959) Feb. (In Russian)

Decay events $\pi^+ - \mu^+ - e^+$ involving two electron tracks originating at the end of a μ -meson track are considered. It is suggested that such cases which occur near the $\mu - e$ decay are due to elastic scattering of positrons on emulsion electrons. (auth)

10359

RELATIVISTIC CORRECTIONS TO PHENOMENOLOGICAL HAMILTONIANS. Yu. M. Shirokov (Lebedev Inst. of Physics, Academy of Sciences, U.S.S.R.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 474-7(1959) Feb. (In Russian)

A general expression was obtained for the relativistic corrections of the order of $(v/c)^2$ to a phenomenologically described nonrelativistic Hamiltonian for the interaction between particles of arbitrary mass and spin. (auth)

10360

MULTIPLE SCATTERING OF POLARIZED ELECTRONS. I. N. Toptygin (Leningrad Polytechnic Inst.).

Zhur. Eksptl'. i Teoret. Fiz. **36**, 488-98(1959) Feb. (In Russian)

Multiple elastic scattering of polarized spin $\frac{1}{2}$ particles in a homogeneous and isotropic medium is considered. Approximate solution of the kinetic equations defining the distribution function and polarization vector of the scattered particles is given. A solution which is valid for small as well as large scattering angles was obtained as a series expansion in spherical functions and spherical vectors. (auth)

10361

ENERGY AND ANGULAR DISTRIBUTIONS IN DIFFRACTIONAL DISINTEGRATION PROCESSES. I. I. Ivanchik and V. S. Popov (Lebedev Inst. of Physics, Academy of Sciences, U.S.S.R.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 499-504(1959) Feb. (In Russian)

The energy and angular distributions were obtained for particles produced in diffractive disintegration of a weakly bound quantum-mechanical system (deuteron, etc). The energy distributions are practically identical with those observed in stripping, whereas the angular distributions are appreciably different. A simple physical explanation of this difference is proposed which may be of importance in interpreting the experimental data. (auth)

10362

DISPERSION RELATIONS FOR THE ELECTROMAGNETIC FORM FACTOR OF THE π -MESON. I. T. Dyatlov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 505-7(1959) Feb. (In Russian)

Dispersion relations are deduced for the electromagnetic form factor of a charged π meson. By considering only the contribution of a state with two π mesons in the imaginary part, an equation was obtained which yields the form factor as a function of the π - π meson scattering phase shifts. (auth)

10363

CALCULATION OF THE SCATTERING PHASE SHIFTS WITH ACCOUNT OF THE SECOND APPROXIMATION. A. A. Sokolov, V. M. Arutyunyan, and R. M. Muradyan (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 594-9(1959) Feb. (In Russian)

The elastic scattering phase shifts for Dirac particles are determined from the interaction potential with account of the second approximation. The results of the Born approximation, damping theory, and the McKinley and Feshbach formula which is a generalization of the Rutherford-Mott formula, can be derived as special cases. (auth)

10364

ON DIFFRACTIVE DISINTEGRATION OF RELATIVISTIC PARTICLES. I. I. Ivanchik (Lebedev Inst. of Physics, Academy of Sciences, U.S.S.R.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 617-18(1959) Feb. (In Russian)

Previously published works dealt with diffractive disintegration of deuterons into black nuclei at deuteron energies $E_d \sim 100$ to 200 Mev. It is shown that the nucleus is also black at $E_d \approx 6$ Bev and that the data are true for the relativistic deuteron. The data are also applied to the diffraction generation processes for π mesons by relativistic protons. (R.V.J.)

10365

SCATTERING OF π -MESONS ON HYDROGEN AT 240 TO 270 MEV. V. G. Zinov and S. M. Korenchenko (Joint

Inst. of Nuclear Research (Dubna, U.S.S.R.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 618-19(1959) Feb. (In Russian)

The elastic and reverse scattering of π^- mesons in hydrogen at 240 to 270 Mev was measured with a scintillation counter and liquid hydrogen target. The total cross sections of π^- meson interactions with hydrogen at 240 to 270 Mev are $(48.3 \pm 3.3) \times 10^{-27} \text{ cm}^2$ and $(36.5 \pm 2.4) \times 10^{-27} \text{ cm}^2$, respectively. (R.V.J.)

10366

ON THE PROBLEM OF ρ^0 MESON. Ya. I. Granovskii (Inst. of Nuclear Physics, Academy of Sciences, Kazakh S.S.R.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 623-4(1959) Feb. (In Russian)

In the compound elementary particle model of Fermi-Jung, the π meson is represented as a system of strongly interacting nucleons with antinucleons. However, along with the π -meson triplet it is possible to form an isotopic singlet from the same bare particles. It is observed that due to the difference in isotopic spins, the force binding nucleons with antinucleons in π^0 and ρ^0 mesons would also be different. In this event the π meson eliminates the ρ^0 meson. An addition of an item into the potential independent of T does not change the inference because such forces are weak. (R.V.J.)

10367

ON VERIFICATION OF PARITY CONSERVATION IN STRONG INTERACTIONS. V. G. Solov'ev (Joint Inst. of Nuclear Research, Dubna, U.S.S.R.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 628-9(1959) Feb. (In Russian)

The process of $\pi + N \rightarrow K + Y$ followed by $Y \rightarrow N + \pi$ decay (Y can be Λ or Σ hyperons) was investigated in order to determine the conservation of parity in strong interactions. (R.V.J.)

10368

POLARIZATION OF μ^+ MESON FLUX AT THE SEA LEVEL. B. A. Dolgoshein and B. I. Luchkov (Moscow Inst. of Engineering Physics). Zhur. Eksptl'. i Teoret. Fiz. **36**, 640-1(1959) Feb. (In Russian)

Experiments were carried out for determining the degree of cosmic μ^+ meson polarization at sea level. The relative quanta of decay positrons emitted in the upper hemisphere, in stopped μ^+ meson decay, were used as the criteria of the measured magnitude. The $\mu^+ \rightarrow e^+$ decays were observed in a large rectangular Wilson chamber. Some 202 events of μ decay showed that in 122 events the positron escaped into the upper hemisphere and in 80 into the lower. Data on the relative positron quanta escaping into the upper hemisphere showed $\beta_{Cu} = 0.604 \pm 0.034$. For verification, the copper plates in the chamber were replaced by iron; the results showed $\beta_{Fe} = 0.516 \pm 0.052$, in good agreement with isotropic distribution $\beta = 0.5$. (R.V.J.)

10369

INTERACTIONS BETWEEN K AND π MESONS. V. I. Ogievetski (Joint Inst. of Nuclear Research, Dubna, U.S.S.R.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 642-3(1959) Feb. (In Russian)

The A. Pais (Phys. Rev. **110**, 574(1958)) hypothesis on parity variance of charged and neutral K particles is analyzed, and an experiment is attempted with K meson pair formation ($\pi + p \rightarrow K^- + K^0 + p$) in order to verify the existence of (K- π) interaction. According to Pais the above reaction is forbidden by the symmetry of baryon-meson interactions and would basically follow the (K- π) interaction. Consequently, the pair formation reaction

can be presented in graphical form where, after virtual $\pi^- - p$ scattering, π^- converts into K^- and K^0 . The angular distribution of K mesons should be assumed to be isotropic if K pair production really results from the (K- π) interaction. However, the isotropy is not accurate as the K bond is considered only in the first approximation. The analysis permits the prediction that the total K meson pulse is directed forward. (R.V.J.)

10370

DEPOLARIZATION OF μ -MESONS IN μ MESOATOM PRODUCTION. I. M. Shmushkevich (Leningrad Inst. of Physics and Tech.). *Zhur. Eksptl'. i Teoret. Fiz.* 36, 645-6(1959) Feb. (In Russian)

The polarization of μ mesons on the K shell of mesic atoms was estimated. Studies were limited to the μ -mesic atoms formed on nuclei with spin 0. (R.V.J.)

10371

ON THE ANNIHILATION OF $\mu^+ - \mu^-$ AND NEUTRAL MESON DECAY. Ya. B. Zel'dovich (Inst. of Theoretical and Experimental Physics, Academy of Sciences, U.S.S.R.). *Zhur. Eksptl'. i Teoret. Fiz.* 36, 646-7 (1959) Feb. (In Russian)

Analogous to $e^+ - e^-$ annihilation, it may be expected that $\mu^+ - \mu^-$ in a pair state should produce two quanta and in the ortho-state three quanta. By observing a reverse process, it was found that along with the $\mu^+ - \mu^-$ annihilation with quantum emission, it is also possible to convert the $\mu^+ - \mu^-$ pair into an $e^+ - e^-$ pair. The latter process follows the same order of $e^2/\hbar c$ as the two-quantum annihilation. The conversion of ortho $\mu^+ - \mu^-$ into $e^+ - e^-$ is about 400 times as probable as the three-quantum annihilation. The pseudo-scalar neutral meson π^0 is similar to the pair state; the π -meson decay into two quanta agrees with the analogy. The neutral odd meson with spin 1 would also be similar to the ortho-state pair; hence such mesons would decay not into three quanta but directly into $e^+ - e^-$ pairs with lifetimes of π^0 . However, there is small chance for observing π producing $e^+ - e^-$ due to the predominant probability of conversion into $2\pi^0$. (R.V.J.)

10372

LECTURES ON NUCLEAR THEORY. C. Landau and Ya. Smorodinsky. New York, Consultants Bureau, Inc., 1958. 80p. \$15.00.

Information is presented on the following: nuclear forces; the scattering of nucleons by nucleons; scattering of nucleons at high energies; nuclear structure; analysis of the magnetic moments of light and heavy nuclei; statistical theory of nuclear reactions; optical properties of the nucleus; the production and transformation of π mesons and their properties; and the interaction of π mesons with nucleons. (J.H.M.)

Heat Transfer and Fluid Flow

10373 APAE-Memo-181

Alco Products, Inc., Schenectady, N. Y.
A BOILING WATER ANALYSIS CODE ON THE IBM-650—ABWAC—MNC PROGRAM NO. 302.
I. Beretsky and S. Pacine. Mar. 10, 1959. 27p. Contract AT(30-3)-326. \$4.80(ph), \$2.70(mf) OTS.

A method was developed for using an IBM-650 data processing machine to obtain detailed information concerning thermal and hydraulic conditions within a plate-type reactor channel when the coolant in the channel is present in both vapor and liquid phases. (auth)

10374 CF-59-1-33(Rev.)

Oak Ridge National Lab., Tenn.
THERMAL STRESS ANALYSIS OF CYLINDRICAL SHELLS. F. J. Witt. Mar. 26, 1959. 28p. Contract [W-7405-eng-26]. \$4.80(ph), \$2.70(mf) OTS.

Part I of this report describes the analysis of a cylindrical shell subjected to a temperature variation in the axial direction. This part is divided into two sections. Section 1 gives the formulas and the procedure for their application. In Section 2, the derivations of the cylindrical shell formulas are given. A cylindrical shell subjected to a linear temperature variation through the thickness is considered in Part II. Part III contains some sample problems which require the methods of Parts I and II for their solutions. Although this part demonstrates the use of the formulas derived, a familiarity with (1) is a prerequisite to an understanding of the material presented. (auth)

10375 IDO-28534

Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. HEAT TRANSFER IN AN ANNULUS WITH ASYMMETRIC HEATING. Final Report. A. V. Lysin, W. V. Mackewicz, and W. C. Reynolds. Feb. 28, 1959. 44p. Contract AT(10-1)-880. \$1.25(OTS).

Previous studies of the heat transfer and fluid flow characteristics of a gas-cooled reactor fuel element of concentric ring design generally treated cases with only one wall heated. In addition, these studies dealt with diameter ratios in excess of two. The objectives of this investigation include: determination of the validity of using tube flow correlations for calculating pressure drop and heat transfer characteristics in thin annuli; investigation of the validity of using Stein's heat flux asymmetry correction for parallel planes to calculate the heat transfer in asymmetrically heated thin annuli; and investigation of the effects of eccentricity on pressure drop, heat transfer, and temperature distribution in concentric ring fuel elements. (auth)

10376 IGR-TN/W-259

United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England.
HEAT TRANSFER TESTS ON ALUMINUM BONDED STAINLESS STEEL HEAT EXCHANGERS. T. I. M. Crofts and D. Gambles. Oct. 21, 1955. Changed from OFFICIAL USE ONLY Mar. 17, 1959. 13p. (IGC-FRDC/P-138).

Heat-cycle tests of aluminum-bonded stainless steel heat exchangers are described. However, full details of the experimental heat transfer work are not given, since the investigation is not complete. A later report will be issued. (J.R.D.)

10377 RDB(W)/TN-160

Gt. Brit. Windscale Works, Sellafield Cumb., England.
CAVITATION IN A VENTURI TUBE PASSING NaK. (78% K.) ALLOY AT 200-300 C. T. I. M. Crofts. Aug. 1954. 18p. (FRDC/P-72).

Tests with NaK (78% K) eutectic alloy at 200 to 300°C in a venturi tube show that cavitation takes place at pressures approaching absolute zero. The effects of gas entrainment and also of a magnetic field were studied. (auth)

10378 SC-4265(TR)

Sandia Corp., Albuquerque, N. Mex.
TABLES OF ISENTROPIC FLOW OF HYDROGEN GAS WITH EQUILIBRIUM COMPOSITION. Kenneth L. Shipley. Dec. 1958. 161p. \$3.00(OTS).

Hydrogen gas dissociates relatively easily at temperatures above approximately 3500°K. When appreciable dissociation occurs, it is necessary to calculate the isentropic flow of hydrogen by methods other than the ideal gas laws. A set of thermodynamic equations is developed (an extension of a work by Penner and Altman, Reference 1), which permits the calculation of isentropic flow of hydrogen with composition change. The equations were coded for an IBM 704 computer. Results of the computation are given in tabular form. Each table gives the results for a given set of initial conditions and lists the temperature, pressure, mass fraction of dissociation, velocity, and nozzle-area ratio as the hydrogen expands through a nozzle. (auth)

10379 WAPD-TM-145

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. F0020—AN IBM-704 THERMAL TRANSIENT ANALYSIS CODE. J. B. Callaghan and J. S. Williams, Jr. Jan. 1959. 41p. Contract AT-11-1-GEN-14. \$1.25 (OTS).

An IBM-704 thermal transient analysis code, designated F0020, was developed to reduce transient test data for a single, vertical, rectangular coolant channel. Modes of heat transfer to water at 2000 psia covered by this code include forced convection (turbulent flow), nucleate boiling, departure from nucleate boiling, partial film boiling, and film boiling. The code will accommodate a plate mesh, and associated heat generation weighting factors, of a maximum of 50 axial and 10 radial nodes. (auth)

10380 WAPD-TM-155

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. HEAT—A ONE-DIMENSIONAL HEAT TRANSFER EQUATION CODE FOR THE IBM-704. C. M. King and R. F. Boyle. Jan. 1959. 15p. Contract AT-11-1-GEN-14. \$0.50(OTS).

An IBM-704 computer code which finds a one-dimensional solution to the general heat transfer equation is presented. Specifically written for application in reactor fuel rod design, the code requires cylindrical geometry conditions and input parameters of surface temperature and power density. The maximum number of points for which temperature values may be obtained is 251, and the approximate running time for a typical problem varies from 1.0 to 2.0 minutes. (auth)

10381 AERE-Lib/Trans-804

WATER AND STEAM CONTENTS IN SURFACE BOILING OF WATER. P. G. Poletavkin and N. A. Shapkin. Translated by R. C. Murray (U.K.A.E.A., Atomic Energy Research Establishment) from *Teploenergetika* 5, No. 4, 54-8(1958). 8p.

The dependence of water and steam contents on heat flux, flow rate, difference between the temperature of the liquid and its saturation temperature, and pressure in water surface boiling was studied. Equations are presented for calculations of water and steam contents in surface boiling, as well as for tubes heated over their whole peripheries. Water and steam contents and heat exchange in exchangers with high heat flux are calculated for a series of cross sections along the length of the channel. (J.R.D.)

10382

THE TEMPERATURE DISTRIBUTION IN A GAS COOLED REACTOR OF SPECIAL FORM. Olavi Hellman. *Ann. Acad. Sci. Fennicae Ser. A*, VI, No. 12, 7p.(1958).

When the form and size of a reactor are given, the neutron flux distribution is known and consequently the heat source distribution. The steady-state temperature distribution in a homogeneous gas-cooled reactor is investigated. (W.D.M.)

10383

THE CHANGE OF THE STATE OF THE COOLANT GAS IN CERTAIN GAS COOLED REACTORS. Olavi Hellman. *Ann. Acad. Sci. Fennicae Ser. A*, VI, No. 13, 8p.(1958).

In all cases where a gas-cooled reactor is used as a source of energy the following basic problem is encountered: given the state of the coolant gas as it enters the reactor, to find the state of the gas as it leaves the reactor. The parameters of the state of the coolant gas are given, and basic equations are derived. (W.D.M.)

10384

THE SURFACE OF HEAT EXCHANGERS AND HEATERS IN GAS TURBINES. Nebojša Gašparović. *Brennstoff-Warme-Kraft* 11, 123-5(1959) Mar. (In German)

With a given quantity of heat transferred to the working medium in the heater and heat exchanger of a gas turbine process, the heater and heat exchanger surfaces can be selected so that first cost reach a minimum value. Consideration of the fuel cost results in a somewhat larger surface of the heat exchanger. (auth)

10385

THE AVERAGE TEMPERATURE DIFFERENCE IN HAIRPIN HEAT EXCHANGERS. H. Hausenblas. *Brennstoff-Warme-Kraft* 11, 114-16(1959) Mar. (In German)

The quantity of heat transferred with counterflow heat exchangers is usually calculated with the mean logarithmic temperature difference. However, for hairpin heat exchangers a different mean temperature is required, and the calculation of the mean temperature difference is shown. (J.S.R.)

10386

VISUAL OBSERVATIONS ON THE WATER STREAM IN AN ELEVATED TEMPERATURE HIGH VELOCITY LOOP. R. E. Seebold (U. S. Naval Research Lab., Washington, D. C.). *Corrosion* 15, 183t-4t(1959) Apr.

The role of oxygen in the corrosion associated with high temperature water systems utilizing low carbon steel containment has been under study for many years. The "in situ" visual effects of oxygen and oxide coatings on the corrosion occurring in a high velocity water loop system at temperatures up to 600 F are described. The visual effects are correlated with previously reported corrosion data measured by physical methods. It is concluded that oxygen inhibits the corrosion process. (auth)

Nuclear Properties and Reactions

10387 AECU-4044

Purdue Univ., Lafayette, Ind. CROSS SECTIONS OF THE FISSION OF U^{235} INDUCED BY INTERMEDIATE ENERGY HELIUM IONS (thesis). Raymond Gunnink. Feb. 1959. 109p. Contract AT (11-1)-347. \$27.30(ph), \$8.10(mf) OTS.

A detailed study of fission was made so that the experimentally obtained total cross section for compound nucleus formation could be compared with theory and so that the fine structure features of fission could be

examined. U^{235} was irradiated with 20 to 40 Mev helium ions. The fission products were separated radiochemically and assayed in calibrated 2π proportional flow and NaI(Tl) crystal scintillation counters. Fission studies made at 39.9, 33.8, 28.2, 23.1, and 20.5 Mev showed several features of fission: The fission is predominantly asymmetric with the symmetric mode increasing rapidly throughout the range. The cross section data obtained corresponds to compound nuclear theory using a radius parameter of $r_0 = 1.5 \times 10^{-13}$ cm. As previously observed for other nuclides, the valley to peak ratio of fission can be related to the excitation energy of the compound nucleus. A fewer number of neutrons emitted per fission is found than previously reported. Other features of fission such as shell effects and the "primary" or "independent" yield problem are also discussed. The appendices contain information on the chemistry separation-schemes, the 4π β - γ coincidence method and the self-absorption, backscattering and geometry factors of a 2π beta proportional flow counter for several fission nuclides. (auth)

10388 AERE-N/R-1438

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

THE FISSION CROSS-SECTION OF URANIUM FOR 147 MEV PROTONS. G. N. Harding. June 1954. 9p.

The fission cross section of natural uranium was measured with 147-Mev protons from the Harwell cyclotron. The fissions were detected in an ionization chamber placed in the external proton beam. The amount of uranium present in the ionization chamber was measured by α -particle counting, and the proton flux was measured by exposing a nuclear emulsion to the beam and counting the number of tracks. The measured cross section is 1.65 ± 0.09 barns. (auth)

10389 AFOSR-TN-59-84

Hebrew Univ., Jerusalem and Israel Inst. of Tech., Haifa.

DETERMINATION OF RELATIVE ABUNDANCE, RATIO OF MAGNETIC MOMENTS, RATIO OF CAPTURE CROSS-SECTIONS OF GADOLINIUM ISOTOPES BY MEANS OF PARAMAGNETIC RESONANCE SPECTRUM. Technical Note No. 5. W. Low and D. Shaltiel. Nov. 1958. 12p. Contract AF61(052)-59. (AD-210144).

Measurements of the hyperfine structure of the transitions corresponding to $\Delta M = 4$ of the cubic field paramagnetic resonance spectrum of gadolinium in single crystals of thorium oxide yields the following values: Isotopic abundance of even isotopes, 69.45%; Gd-155, $15.05 \pm 0.2\%$; and Gd-157, $15.5 \pm 0.2\%$. Ratio of magnetic moments, $\mu_{155}/\mu_{157} = 0.7495 \pm 0.0045$. Crystals irradiated at the Harwell pile with a thermal neutron flux of 1.2×10^{12} n/cm²/sec, and a fast flux of 2.3×10^{11} n/cm²/sec, yield the ratio of nuclear capture cross sections $\sigma_{157}/\sigma_{155} = 2.82$, using the above abundance values. No F center spectrum was detected in crystals irradiated with a total neutron flux of about 10^{18} n/cm². The paramagnetic resonance spectrum of gadolinium in irradiated crystals is unchanged indicating negligible radiation damage in the neighborhood of the paramagnetic ions. (auth)

10390 CF-59-2-83

Oak Ridge National Lab., Tenn.

CROSS SECTION PROGRAM AT ORNL. J. A. Harvey and J. L. Fowler. Feb. 25, 1959. 13p. Contract [W-7405-eng-26]. \$3.30(ph), \$2.40(mf) OTS.

The ORNL pulsed Van de Graaff was used with a large

liquid scintillator to study neutron capture cross sections as a function of neutron flight time. Final values for the $RdTh(D_2O)$ activation cross sections are given. Coulomb excitation of the first 2^+ state was measured for 14 even-even nuclei. Transmission measurements on Lu^{178} , Lu^{176} , and Am^{241} were analyzed to yield resonance parameters. The various programs at ORNL to determine σ_{γ} for U^{233} and U^{235} are discussed. (W.D.M.)

10391 HW-58596

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

TRANS-PLUTONIUM ISOTOPE BUILDUP BY NEUTRON IRRADIATION OF PLUTONIUM. F. P. Brauer and Helen H. Burley. Dec. 15, 1958. 47p. Contract W-31-109-Eng-52. \$1.25(OTS).

Graphs suitable for estimating the plutonium and trans-plutonium isotopic content of irradiated plutonium reactor fuel of various initial isotopic compositions are presented. The curves were computed for a neutron flux of 5×10^{13} n/cm²/sec and for irradiation times up to ten years. (auth)

10392 NP-7317

Institut Interuniversitaire des Sciences Nucleaires, Brussels.

LA MATIERE NUCLÉAIRE CONSIDÉRÉE COMME LIQUIDE DE FERMI. (Nuclear Matter Considered as a Fermi Liquid.) L. Van Hove. Feb. 1958. 70p.

A series of lectures on nuclear matter is presented. The work done at Utrecht in the area of the general theory of systems of N Fermi particles, application of the theory to nuclear matter, and a critical survey of the works of Brueckner are discussed. An introduction and history, the Hamiltonian, a general study of the resolvent by the method of perturbations, matrix element of the resolvent R_z for the ground state, study of the ground state, wave function of the ground state, excited states, singular forces, case of low densities, the Brueckner theory, numerical results for E_0 , and unresolved problems are considered. (J.S.R.)

10393 NP-7343

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy.

NEUTRAL PION PRODUCTION IN 9 BEV PROTON INTERACTIONS WITH EMULSION NUCLÉI. G. Z.

Baitian (Baityan), I. M. Gramenitskii (Gramenitsky), A. A. Nomofilov, M. I. Podgoretskii (Podgoretsky), and E. S. Skrzypczak. 1958. 7p.

The average energy value $\bar{E}_\pi = 750 \pm 180$ Mev of π^0 mesons appearing in 9-Bev proton interactions with emulsion was determined. The energy carried away by pions in these interactions is within the limits $27 \pm 7\%$ to $33 \pm 8\%$. The experimental setup is described. (W.D.M.)

10394 TNCC(Can)-9

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

ON THE USE OF Lu^{176} AS AN ACTIVATION DETECTOR FOR MEASURING THE TEMPERATURES OF THERMAL NEUTRONS AND ON THE NEED FOR BETTER $\sigma_\gamma(E)$ DATA FOR THIS ISOTOPE. F. Brown and C. H. Westcott. May 8, 1957. 4p.

Natural Lu is 2.6% Lu^{176} and the remainder Lu^{175} . The resonance at 0.15 ev is attributed to Lu^{176} which produced Lu^{177} of 6.8 days half life (β, γ). The isotopic cross section for 2200 m/sec neutrons is $\sim 4,000$ barns. This means that 1 mg of natural Lu in a flux of 10^8 n/cm²/sec for 1 hr gives $\sim 1.5 \times 10^2$ dps. Half-life measurements of the β decay of foils irradiated for 1 min in

an NRX self-service position show that no interfering activities are produced (after allowing the decay of the 3.7 hr Lu^{178m}) and that the half life agrees with the literature value of 6.8 days. The same is true for total γ -ray measurements on foils irradiated in the NRX "rabbit" for 1 hour. The activities induced in the Al backings (0.001 in.) are negligible compared to the Lu activities. The weight of Lu in these foils was not known but should lie between 0.1 and 1 mg/cm^2 . The γ -ray spectrum obtained with NaI crystal shows the expected peaks at 0.317 kev (weak), 0.206 kev, and 0.113 kev, together with the x-ray peak and its escape peak at ~ 60 and ~ 30 kev, respectively. (A.C.)

10395 TNCC(Can)-11

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

RADIOCHEMICAL MEASUREMENTS OF THE NEUTRON CAPTURE CROSS SECTIONS OF SOME FISSION PRODUCTS AND PROTOACTINIUM-233. T. A. Eastwood, A. P. Baerg, F. Brown, W. E. Grummitt, J. C. Roy, and L. P. Roy. Mar. 1958. 21p.

A survey made in 1957 showed that neutron cross sections were lacking for about 15% of fission products of potential significance in power reactors. To remedy this situation, a number of measurements were made and are summarized. The methods used for the various measurements are given. (A.C.)

10396 JPRS-362

FORMATION OF Re^{188} IN THE IRRADIATION OF TUNGSTEN BY SLOW NEUTRONS. B. S. Dzhelepov, N. D. Novosil'tseva, and P. A. Tishkin. Translated from *Izvest. Akad. Nauk S.S.S.R., Ser. Fiz.* **18**, 76-8 (1954). 5p. (PB-141260-T). \$0.50(OTS).

Upon studying the β spectrum of neutron-irradiated tungsten which had been stored more than a month, a weaker and harder component was found than the soft component which has a limit of 0.405 Mev. It was concluded that the activity could be ascribed to sequential capture by W^{186} of two neutrons giving rise to W^{188} and the conversion of the latter to Re^{188} . The chemical separations for the Re^{188} are described. (W.D.M.)

10397

NEUTRONS FROM (α, n) SOURCES. Wilnot N. Hess (Univ. of California, Berkeley). *Ann. Phys. (N. Y.)* **6**, 115-33(1959) Feb.

The neutron energy spectra and yields for several (α, n) neutron sources are calculated and compared with experimental values. (auth)

10398

PERTURBATION THEORY IN NUCLEAR REACTIONS. G. E. Brown (Univ. of Copenhagen); C. T. DeDominicis (Centre d'Etudes Nucleaires, Saclay, France); and J. S. Langer (Univ. of Birmingham, Eng.). *Ann. Phys. (N. Y.)* **8**, 209-29(1959) Mar.

Exact expressions for the amplitudes for scattering of a particle by a complex nucleus are written down. It is then shown that, with a particular weight function, the scattering amplitude can be averaged over energy by going to a complex energy, i.e., $[S(E)]_{AV} = S(E + iI)$, where I is the interval averaged over. The average amplitude is then expressed in terms of a perturbation expansion. In perturbation theory of the first kind, expansion in powers of the interaction potential between the incident particle and the particles in the nucleus is carried out. In the second kind of perturbation theory,

all particles are treated symmetrically and all but the average effects of the interactions are treated as perturbations. This allows one to relate the parameters of the optical potential back to nucleon-nucleon forces. It is shown that these expansions are, in general, convergent, due to the fact that the excitation into which a given excitation decays has a longer lifetime than the original one. (auth)

10399

DISTRIBUTION RADIUS OF THE NUCLEAR CHARGE AND BINDING ENERGY. Tsen Tsin-Yan. *Acta Phys. Sinica* **13**, No. 5, 257-64(1957). (Translated from *Referat. Zhur. Khim.* No. 11, 1958, Abstract No. 35055.)

On the basis of an experimental analysis (high-energy electron scattering and x-ray spectra of μ -mesonic atoms) it is concluded that the distribution radius of a nuclear charge R_p corresponds to the atomic number $Z^{1/2}$ relation instead of the ordinary $R_p \approx A^{1/3}$ relation. On that assumption the semi-empirical mass formula was modified. The coulomb energy term is expressed in the form $(3/5)Z^2e^2/r_{op}Z^{1/2}$. The nuclear binding energy calculated on applying the new formula coincides better with the experimental data than in the case of the old Bethe-Weizacker formula. The new formula also predicts very accurately the mass numbers of the most beta-stable nuclei.

10400

A MASS SPECTROMETER WITH A LOW-TEMPERATURE IONIZATION CHAMBER TO STUDY HETEROGENEOUS REACTIONS OF ATOMS AND FREE RADICALS: EXAMPLE, IODINE ATOMS. L. P. Blanchard and P. Le Goff (Univ. of Nancy, France). *Can. J. Chem.* **37**, 515-19(1959) Mar.

The main features of a mass spectrometer in which the ionization chamber can be cooled in a controlled way to the temperature of liquid nitrogen are given. Atoms or free radicals, formed in a heterogeneous quartz reactor that can be heated to 1000°C , effuse through a small hole in the wall of this reactor and enter directly into the ionization chamber. With this instrument it is possible to study the various ways in which unstable particles disappear during collisions on a metallic surface maintained at low and controlled temperatures. The collision efficiency "b" of iodine atoms to form iodine molecules was found to vary between 1.7×10^{-3} and 4×10^{-3} on a surface at a temperature between $+40^\circ\text{C}$ and -25°C . Between -25°C and -60°C , the atoms are condensed at the same time as the iodine molecules; at lower temperatures, they are more "volatile" than iodine molecules, most of them colliding on the molecules of condensed iodine without reacting. (auth)

10401

SOME YIELDS IN THERMAL NEUTRON FISSION OF U^{233} AND Pu^{239} . Rosalie M. Bartholomew, J. S. Martin, and A. P. Baerg (Atomic Energy of Canada, Ltd., Chalk River, Ont.). *Can. J. Chem.* **37**, 660-3(1959) Apr.

Relative yields of Sr^{88} , Sr^{91} , Ba^{139} , Ba^{140} , and La^{141} have been measured for U^{233} and Pu^{239} thermal neutron fission. Ion exchange separations and 4π beta-counting methods were used. The following relative values were obtained for the nuclides as listed: 1.05, 1.00, 1.00, 1, and 1.10 in U^{233} fission and 0.301, 0.431, 1.07, 1, and 1.01 in Pu^{239} fission. (auth)

10402

THE THEORY OF THE PHOTONUCLEAR REACTION USING THE INDEPENDENT PARTICLE MODEL OF THE NUCLEUS. Seiichi Sueoka (National Research Council, Ottawa). *Can. J. Phys.* **37**, 232-43(1959) Feb.

For high-energy photonuclear reactions, particularly for the direct emission of a neutron, the integration of the matrix element of the interaction energy of the nucleus and the radiation field is carried out without the usual expansion in a series of multipoles. The method is applied to the O^{16} , O^{17} nuclei, with harmonic oscillator wave functions for the nucleus. The ratio of the cross section obtained by the present method and that by considering only dipole absorption is found for various γ -ray energies. (auth)

10403

SPIN DEPENDENCE OF NUCLEAR LEVEL SPACINGS. A. G. W. Cameron (Atomic Energy of Canada, Ltd., Chalk River, Ont.). *Can. J. Phys.* **37**, 244-5(1959) Feb.

A correction factor for an improved nuclear level spacing formula is given. This factor improves the fit of the level spacing formula to the observed spacings in nuclei with target spins of $\frac{5}{2}$ and $\frac{7}{2}$ but worsens it slightly for target spins of $\frac{3}{2}$. The use of this factor to correct the level spacing will reduce the discrepancies in charged-particle reactions by a factor typically about three for intermediate nuclei. (J.H.M.)

10404

MULTIPLE NEUTRON CAPTURE IN THE MIKE FUSION EXPLOSION. A. G. W. Cameron (Atomic Energy of Canada, Ltd., Chalk River, Ont.). *Can. J. Phys.* **37**, 322-33(1959) Mar.

The constant ratio of yields of successive even or odd mass number nuclides produced in the Mike fusion explosion of 1952 implies an approximate constancy of the corresponding neutron capture cross sections for neutrons near 100 kev for the nuclei between U^{238} and U^{254} . A discussion is given of the physical quantities on which the neutron capture cross sections depend, particularly radiation widths, nuclear level spacings, and neutron binding energies. It is concluded that conventional mass formulas are probably wrong in predicting a large decrease in neutron binding energy as one goes from U^{238} to U^{254} . It is possible that the addition of a direct symmetry term to the mass formula might repair this difficulty. Another possibility is that an extra diffuseness of the nuclear surface in neutron-rich nuclei would reduce the Coulomb energy of the nucleus, thus stabilizing neutron binding energies. (auth)

10405

GAMMA RADIATION FROM THE $U^{238}(n,\gamma)U^{239}$ REACTION. P. J. Campion, J. W. Knowles, G. Manning, and G. A. Bartholomew (Atomic Energy of Canada, Ltd., Chalk River, Ont.). *Can. J. Phys.* **37**, 377-81(1959) Mar.

The γ rays following thermal neutron bombardment of a target consisting of 200 g of U metal with the U^{238} content depleted to approximately 0.034% were examined with a pair spectrometer and a flat-crystal diffraction spectrometer. With the former instrument the region between 7.7 and 3.0 Mev was surveyed using a resolution of about 3%, and studied in more detail between 4.2 and 3.4 Mev with a resolution of 1%. The energy range from 3.4 to 0.14 Mev was examined with a crystal spectrometer. The spectra are graphically shown for the region in the neighborhood of 0.6 Mev. (A.C.)

10406

OPTICAL RESONANCE OF CADMIUM VAPOR WITH SEPARATED ODD AND EVEN ISOTOPES. Marthe Spitzer. *Compt. rend.* **248**, 786-7(1959) Feb. 9. (In French)

Experiments on optical resonance were made on cadmium vapor with the isotopes distinguished by the 3261 Å line. The degree of polarization observed was 0.95 for the 114 isotope and 0.44 for the 111 and 113 isotopes instead of 0.81 for the natural mixture. This result confirms the influence of nuclear spin in the explanation of the phenomena. (tr-auth)

10407

MEASUREMENT OF THE EFFECTIVE CROSS SECTION OF THE REACTION $Ta^{181}(\gamma,p)Hf^{180}$ PRODUCED BY γ RAYS OF 14.8 AND 17.6 Mev. Wilfrid Sébaoun and Henri Gauvin. *Compt. rend.* **248**, 791-3(1959) Feb. 9. (In French)

The effective cross section of the $Ta^{181}(\gamma,p)Hf^{180}$ reaction was measured with 14.8- and 17.6-Mev γ rays. The value obtained with the intensity ratio of $I_{14.8}/I_{17.6} = 0.5$ was $\sigma = (1.6 \pm 1.2) \times 10^{-28}$ cm². The error indicated contains the statistical errors on the counting of the tracks and stars and the imprecision of the value of σ_0 used. According to the results of Whalin and Hanson (*Phys. Rev.* **89**, 324(1953)), the cross section of the reaction $Ta^{181}(\gamma,n)Ta^{180}$ is of the order of 0.21×10^{-24} cm². The ratio $\sigma_{\gamma,p}/\sigma_{\gamma,n}$ of the cross sections of these reactions is 7.6×10^{-2} , a value higher by a factor of 10^3 than the value calculated from the statistical theory. This result indicates the predominance of the direct effect in the $Ta(\gamma,p)$ reaction. (tr-auth)

10408

THE DISINTEGRATION OF THE NUCLEUS OF CARBON-12 INTO THREE α PARTICLES. Jean Yaccoz. *Compt. rend.* **248**, 952-4(1959) Feb. 16. (In French)

The α model is used to interpret the decomposition of carbon-12 at high energies. (tr-auth)

10409

MEASUREMENT OF THE AVERAGE NUMBER OF PROMPT NEUTRONS EMITTED DURING THE FISSION OF PLUTONIUM-239 INDUCED BY 14.2-Mev NEUTRONS. Jean Leroy. *Compt. rend.* **248**, 954-6(1959) Feb. 16.

The average number ν^{239} of prompt neutrons emitted during the fission of Pu^{239} induced by 14.2-Mev neutrons was measured by comparison with the average number ν^{238} of prompt neutrons emitted during the fission of U^{238} with 14.2-Mev neutrons. The value obtained is $\nu^{239} = 4.75 \pm 0.4$. (tr-auth)

10410

PERIODS OF THE EXCITED LEVELS OF GADOLINIUM-155. Michel Vergnes. *Compt. rend.* **248**, 1158-61(1959) Feb. 23. (In French)

The excited levels of Gd^{155} were studied. The 86.5- and 105.4-kev photons deexcite two levels at 86.5 and 105.4 kev. The measurement of the periods of these levels gave $T_{86.5} = (5 \pm 1) \times 10^{-6}$ sec and $T_{105.4} = (1.2 \pm 1) \times 10^{-6}$ sec. The measurement of the conversion coefficients shows that the photons are E_1 . (tr-auth)

10411

SOME COMMENTS ON THE DECAY SCHEME AND DOSIMETRY OF Ca^{45} . S. Block (Univ. of California, Livermore). *Health Phys.* **1**, 357(1958) Dec.

A note on proper interpretation of the cesium-137 decay scheme is presented. A correct decay scheme is included, and factors to be used in calculations are explained. (J.R.D.)

10412

NUCLEAR REACTIONS AND ELEMENT SYNTHESIS IN STELLAR ATMOSPHERES. E. M. Burbidge, G. R. Burbidge, and William A. Fowler (California Inst. of Tech., Pasadena). Intern. Astron. Union Symposium No. 6, 222-36(1958).

A modified discussion of surface nuclear reactions in magnetic stars is given. The anomalous abundance effects found in magnetic stars are briefly described. It is suggested that the processes of particle acceleration are similar to those taking place in the solar atmosphere which give rise to the cosmic ray bursts observed by Wild, Roberts, and Murray, and to the solar component of cosmic radiation. Calculations of the rate of loss of energy following particle acceleration suggests that the duration of the hot spot is $1 \lesssim$ sec. It is estimated that in the region of acceleration (p,n) reactions will enable a ratio $n_n/n_p \approx 10^{-2} - 10^{-3}$ to be built up. The majority of these neutrons will diffuse from the excited regions and form deuterium in the quiescent atmosphere. This deuterium will be continuously built up and re-acceleration will lead to the release of neutrons, some of which will be captured by the Fe group, eventually giving rise to the observed anomalous abundances of the heavy elements. Also the reaction $H(d,\gamma) He^3$ may give rise to the formation of some He^3 . (auth)

10413

SCATTERING OF HIGH-VELOCITY NEUTRAL PARTICLES BY AN ORIENTATION DEPENDENT POTENTIAL. Oktay Sinanoglu (Univ. of California, Berkeley). J. Chem. Phys. 30, 850-1(1959) Mar.

The cross sections for high-velocity scattering of He and Ar in thermal N_2 obtained by Amdur et al. (J. Chem. Phys. 27, 527(1957)) are treated to obtain orientation-dependent cross sections. (T.R.H.)

10414

THE THERMAL NEUTRON ABSORPTION CROSS-SECTION OF ^{240}Pu . J. Halperin, J. O. Oliver, and H. S. Pomerance (Oak Ridge National Lab., Tenn.). J. Inorg. & Nuclear Chem. 9, 1-2(1959) Jan.

A measurement of the thermal neutron absorption cross section of Pu^{240} has been made using the Oak Ridge Pile Oscillator. Enriched Pu^{240} samples and almost isotopically pure Pu^{239} samples were compared with gold standards. All samples were sufficiently thin so as to offer negligible self protection. The Pu^{240} was found to give a response per atom 2.94 times that of gold. Upon correcting for the non-(1/v) character of Pu^{240} absorption, a value of 285 ± 15 barns is computed for the 2200 m/sec absorption cross section. The value of 314 ± 30 barns calculated from the resonance parameters of Pu^{240} is in agreement with this measurement. (auth)

10415

THE HALF-LIFE OF ^{89}Sr . R. G. Osmond and M. J. Owers (United Kingdom Atomic Energy Authority, Woolwich Outstation, London). J. Inorg. & Nuclear Chem. 9, 96-8(1959) Jan.

The half life of Sr^{89} is found to be 50.36 ± 0.18 days, taking into account the possible contributions from Sr^{85} and Sr^{90} . (L.T.W.)

10416

STUDY OF Ho^{165} . L. Grenags and A. Meessen (Univ. of Louvain, Belgium). J. phys. radium 20, 61-2(1959) Jan. (In French)

The gamma radiation of Dy^{165} in its transformation to Ho^{166} was studied. The existence of two cascades 630-360 kev and 270-710 kev was confirmed. The first cascade shows a metastable nature for the 360-kev level, the life of which was determined to be higher than 2.5×10^{-7} sec. The second cascade was used to measure the angular correlations. (J.S.R.)

10417

GAMMA RAYS FROM THE PROTON BOMBARDMENT OF ^{24}Mg , ^{25}Mg , AND ^{26}Mg . Iwao Miura, Tetsuo Wakatsuki, Yasuo Hirao, and Elji Okada (Osaka Univ.). J. Phys. Soc. Japan 14, 239-47(1959) Mar.

The gamma rays following the inelastic scattering of protons by Mg^{24} , Mg^{25} , and Mg^{26} were investigated at proton energies up to 5.7 Mev. The energy spectra of the gamma-rays at several proton energies have been obtained for each isotope. 2^+ was assigned to the second, third, and fourth excited level of Mg^{26} considering the gamma-ray branching ratios for those levels. The yields of gamma rays from the first excited levels were found to have peaks at proton energies of 4.0, 4.6 and 5.05 Mev for $Mg^{24}(p,p'\gamma)$ reaction and 4.9 and 5.4 Mev for $Mg^{26}(p,p'\gamma)$ reaction, respectively. These resonances correspond to the levels at 6.1, 6.7 and 7.14 Mev for Al^{25} , and 13.0 and 13.5 Mev for Al^{27} . To determine the spins for those levels, angular distributions were measured at resonance energies. Spin values of $\frac{3}{2}$ and $\frac{5}{2}$ are probable for 7.14 Mev level in Al^{25} and 13.0 Mev level in Al^{27} , respectively. For the 13.5 Mev level in Al^{27} , the spin of $\frac{3}{2}$ is also probable, but $\frac{5}{2}$ can not be excluded because of the presence of the cascade gamma rays from higher levels. The total cross sections for the gamma-ray emission are estimated to be about 700 mb at 5.05 Mev resonance for Mg^{24} and a few hundred mb for the 4.9 and 5.4 Mev resonances for Mg^{26} . (auth)

10418

TERTIARY AND GENERAL-ORDER COLLISIONS. L. M. Delves (Clarendon Lab., Oxford). Nuclear Phys. 9, 391-9(1959) Jan. (1).

The general formalism of scattering theory is extended to cover reactions in which more than two particles exist in the entrance or exit channels, and the behavior of the scattering matrix in this general case is discussed at arbitrary energies, in particular near thresholds. The energy dependence of observable quantities such as cross-sections and polarizations is given, and the occurrence and origin of the Wigner cusps and their counterpart in the general case are clearly seen; such singularities do not arise from the behavior of the eigenphase-shifts. Coulomb effects are not considered in the general case. (auth)

10419

ON THE ENERGY DEPENDENCE OF THE ANISOTROPY OF HIGH-ENERGY NUCLEAR INTERACTIONS.

G. Bozoki and Eva Gombosi (Central Research Inst. of Physics, Budapest). Nuclear Phys. 9, 400-11(1959) Jan. (1).

The energy dependence of the anisotropy parameter X defined for high-energy nuclear interactions has been determined in nucleon-nucleon and nucleon-nucleus collisions according to the Landau theory of meson

production. An empirical formula $X = (0.82^{+0.06}_{-0.07})\gamma_c^{(0.35 \pm 0.04)}$ is given for the variation of the degree of anisotropy with γ_c , the Lorentz factor of the CMS in the 10^{10} – 10^{14} eV energy range. It is shown on the basis of available experimental data that contrary to expectation no correlation is to be found between the number of shower particles n_s and the anisotropy, if $\gamma_c > 10$ and $n_s > 4$. An evaluation of the data on the basis of the "excited nucleon" model of meson production is given in the appendix. (auth)

10420

ON THE POLARIZATION OF NUCLEONS IN HIGH ENERGY STRIPPING REACTIONS. A. G. Sitenko (Physico-Technical Inst., Ukrainian SSR, Academy of Sciences, Kharkov). Nuclear Phys. 9, 412–19(1959) Jan. (1).

Polarization of nucleons stripped from deuterons in high energy encounters with nuclei is determined on the basis of the generalized diffraction method in which account is taken of spin-orbit interaction. (auth)

10421

THEORY OF DIRAC PARTICLES WITH ORIENTED SPINS AND PARITY NON-CONSERVATION. A. A. Sokolov (Moscow State Univ.). Nuclear Phys. 9, 420–5(1959) Jan. (1).

The Liders-Pauli theorem is investigated in connection with a type of theory chosen to describe Dirac particles with oriented spins. (auth)

10422

STRANGE PARTICLE CONTRIBUTION TO THE MAGNETIC MOMENT OF THE NUCLEON. Kailash Kumar and S. N. Biswas (Tata Inst. of Fundamental Research, Bombay). Nuclear Phys. 9, 446–8(1959) Jan. (1).

The contribution of the strong Hyperon–K-meson–nucleon interaction to the nucleon magnetic moment has been calculated, to the first order. In order to fit the observed values with pseudoscalar K-mesons one needs $g_{\pi}^2/4\pi = 9.6$ and $g_{KN\pi}^2/g_{\pi}^2 = 0.06$. If, however, the K-meson is assumed to be scalar, the last ratio becomes 0.016, which is perhaps too small, and $g_{\pi}^2/4\pi$ in this case is 11.3. (auth)

10423

ON THE STRUCTURE OF ROTATIONAL LEVELS OF ATOMIC NUCLEI. K. Wildermuth and Th. Kanellopoulos (CERN, Geneva). Nuclear Phys. 9, 449–75(1959) Jan. (1).

It is shown that two kinds of nuclear rotational levels exist. The first kind appears in light nuclei, but a clear rotational energy spectrum is only very seldom connected with this. The second kind appears rather regularly in heavy nuclei with large deformations. There are two other main differences between these two kinds of rotational levels. If in light nuclei a rotational energy spectrum is present, then this spectrum always breaks off abruptly, in contrast to the second kind of rotational spectrum. The second main difference is that the ratios of the γ -transition probabilities for the second kind of rotational levels can be described by the collective model. As opposed to this, the corresponding ratios of the first kind are reduced strongly compared with the values of the collective model. At the end of the paper more general questions are briefly discussed. (auth)

10424

STRANGE PARTICLE DECAYS AND THE UNIVERSAL V–A FOUR-FERMION INTERACTION. S. Oneda

(National Research Council, Ottawa). Nuclear Phys. 9, 476–97(1959) Jan. (1).

The branching ratios of various decay modes of K-meson are discussed on the basis of a universal vector and axial-vector four-fermion interaction. The simplest and most straightforward interpretation of the results leads to the following tentative conclusion: The (squared) coupling constant of the strangeness non-conserving baryon-lepton interactions, such as the $\Lambda^0 \rightarrow p + e^- + \bar{\nu}$ or $\Sigma^- \rightarrow n + e^- + \bar{\nu}$, is smaller than the usual Fermi coupling constant (1.4×10^{-49} erg·cm³)² by, at least, one order of magnitude. This is rather consistent with the recent observations on the hyperon decays into leptons. Alternative possibilities which may enable us to avoid this conclusion are also discussed. An example is to expect strong final state interactions in the $K^0 \rightarrow \pi^+ + \pi^-$ decay. Also phenomenological estimates of the decay rates of $\Lambda^0 \rightarrow p + e^- (\mu^-) + \bar{\nu}$ from the experimentally known rates of $K \rightarrow \mu + \nu$ and $K \rightarrow \pi + e(\mu) + \nu$ decays are made. It is concluded that the computed lower limits of the rates are not in contradiction with the present experimental information. (auth)

10425

INFLUENCE OF THE FINITE DIMENSIONS OF THE NUCLEUS ON THE RELATIVE CONVERSION COEFFICIENTS IN THE L-SUBSHELLS. A. G. Sergeev, V. D. Vorobyev, A. S. Remenny, T. I. Kolchinskaya, G. D. Latyshev, and Yu. S. Yegorov (V. N. Obraztsov Inst. of Railway Engineering, Leningrad). Nuclear Phys. 9, 498–508(1959) Jan. (1).

Measurements have been made of the relative internal conversion coefficients in the L-subshells for three pure M1 transitions: 46.5 keV in Bi²¹⁰, and 115.1 and 238.6 keV in Bi²¹². It is shown that in order to obtain agreement with the experimental data, it is necessary to take into consideration the finite dimensions of the nucleus in the theoretical calculations of the L internal conversion coefficients. Measurements have also been made of $L_I : L_{II} : L_{III}$ for the 277.3 keV M1 transition in Pb²⁰⁸. (auth)

10426

RESONANCE ENERGIES AND HALF-WIDTHS FOR PROTON CAPTURE IN ALUMINIUM. S. L. Andersen, H. Bø, T. Holtebekk, O. Lönsjö, and R. Tangen (Univ. of Oslo). Nuclear Phys. 9, 509–18(1959) Jan. (1).

A description is given of the methods used to obtain precise values for the resonance energies and half-widths in proton capture reactions. A target chamber designed for this purpose is described. Proton capture in Al²⁷ has been investigated in the proton energy range 500 keV to 1400 keV. For all known resonances energy values are given. For some of the resonances the true half-widths and for the rest upper half-width limits are given. (auth)

10427

SHAPE FACTORS FOR FIRST FORBIDDEN NON-UNIQUE BETA TRANSITIONS. A. H. Wapstra (Inst. voor Kernfysisch Onderzoek, Amsterdam). Nuclear Phys. 9, 519–27(1959) Jan. (1).

New approximations are developed for the shape factors in non-unique beta decay. Simplifications are possible because the combination of the so-called forbidden beta-decay functions $(L_\mu M_\nu)^{1/2} \pm N_\nu$ (upper sign for negatons, lower sign for positrons) is very small as compared to the functions themselves. (auth)

10428

CONVERSION COEFFICIENTS OF GAMMA TRANSI-

TIONS IN ^{203}Tl . G. J. Nijgh, A. H. Wapstra, L. Th. M. Ornstein, N. Salomons-Grobbe, and J. R. Huizenga (Inst. voor Kernfysisch Onderzoek, Amsterdam) and O. Almén (Chalmers Univ. of Tech., Goteborg). Nuclear Phys. 9, 528-37(1959) Jan. (1).

Conversion coefficients in Tl^{203} are determined as $\alpha_K = 0.163 \pm 0.003$, $\alpha_L = 0.0487 \pm 0.0012$ for the 279.12 kev gamma transition, and $\alpha_K = 0.118 \pm 0.011$ for the 404 kev transition. These results are discussed in view of possible deviations from theoretical values for M1 and E2 conversion coefficients. The decay energy of Pb^{203} is estimated to be 950_{-10}^{+300} kev. (auth)

10429

CONVERSION COEFFICIENTS OF GAMMA TRANSITIONS IN ^{180}Hg . A. H. Wapstra, G. J. Nijgh, N. Salomons-Grobbe, and L. Th. M. Ornstein (Inst. voor Kernfysisch Onderzoek, Amsterdam). Nuclear Phys. 9, 538-44(1959) Jan. (1).

The K and L conversion coefficients of the 412 kev E2 transition following the decay of Au^{180} are measured to be 0.0281 ± 0.0005 and 0.0097 ± 0.0004 . Both values are about 10% lower than the theoretical values. The main beta spectrum of Au^{180} agrees with the theoretical shape for first forbidden non-unique spectra; its endpoint is 966 ± 3 kev. (auth)

10430

CONVERSION COEFFICIENTS FOR ELECTRIC QUADRUPOLE TRANSITIONS. G. J. Nijgh and A. H. Wapstra (Inst. voor Kernfysisch Onderzoek, Amsterdam). Nuclear Phys. 9, 545-50(1959) Jan. (1).

The measured K and L shell conversion coefficients of the 412 kev transition in Hg^{180} and the 279 kev transition in Tl^{203} are compared with the results of calculations by Rose and by Sliv and Band which are corrected for effects due to the finite nuclear size. The experimental results do not completely agree with the theoretical values, although neither E2 transition is delayed. (auth)

10431

ON THE DIRECT NEUTRON EXCHANGE INTERACTION OF COMPLEX NUCLEI INVOLVING A POSSIBLE LARGE CHANGE OF THE NUCLEAR SPINS. V. I. Goldansky (P. N. Lebedev Physical Inst., USSR Academy of Sciences, Moscow). Nuclear Phys. 9, 551-7(1959) Jan. (1).

It is shown that it may be possible to observe a process of direct interaction of complex nuclei in which these nuclei, being on the outer boundary of the Coulomb potential barrier, exchange neutrons. If the neutrons in the outer shells have large momenta, their exchange may result in a large change of the spins of the interacting nuclei and in the excitation of otherwise inaccessible levels, corresponding to all possible values of the nuclear spin and its projection for different arrangements of a given number of neutrons in the outer shell. (auth)

10432

UNRENORMALIZABLE INTERACTIONS AND THE STRUCTURE OF ELEMENTARY PARTICLES. J. Strathee and Y. Takahashi (Dublin Inst. for Advanced Studies). Nuclear Phys. 9, 558-60(1959) Jan. (1).

A possible relation of the unrenormalizable interactions to the internal structure of elementary particles is approached with the help of a simple model. A non-local, charge-independent, and CP (combined) invariant

interaction is examined and a simple connection is found to emerge between the problems of parity violation in weak interactions and the divergence of self-energy. The connection involves a supposed universal fundamental length. (auth)

10433

INTERACTION OF FAST NEUTRONS WITH FLUORINE. E. Kondalah, C. Badrinathan, and K. V. K. Iyengar (Tata Inst. of Fundamental Research, Bombay). Nuclear Phys. 9, 561-8(1959) Jan. (2).

Fluorine targets were irradiated with fast neutrons arising from D(d,n) , Be(d,n) , and T(d,n) reactions using the deuterons accelerated in a one million volt Cockcroft-Walton accelerator. Resulting charged particle spectra and low energy gamma ray spectra were studied. Using 15 Mev neutrons, the charged particle spectrum showed a small hump at (10.6 ± 0.8) Mev which is consistent with a 10.5 Mev alpha group leading to the ground state of N^{16} in $\text{F}^{19}(\alpha, \alpha)\text{N}^{16}$ reaction. The gamma spectra showed mainly 110 ± 8 kev and 195 ± 10 kev gamma rays. Relative intensities of these gamma rays at each of the neutron energies are given. Gamma rays of 300 kev and 390 kev energy that might arise in $\text{F}^{19}(\alpha, \alpha)\text{N}^{16}$ reaction were looked for but not observed. Upper limits on their intensities with respect to 110 kev gamma rays are given. No real coincidence effect was found between 110 kev and 195 kev gamma rays up to 10μ sec delay. (auth)

10434

RADIATIVE CAPTURE CROSS SECTIONS FOR NEUTRONS OF A Sb-Be SOURCE. J. F. Vervier (Universite de Louvain, Belgium). Nuclear Phys. 9, 569-76(1959) Jan. (2). (In French)

Radiative capture cross sections of 7 isotopes for 25-kev Sb-Be photoneutrons have been measured by comparison with the corresponding thermal neutron cross sections; the agreement with previous measurements is satisfactory. (auth)

10435

QUASI-FREE NUCLEON-NUCLEON SCATTERING. Th. A. J. Maris (Florida State Univ., Tallahassee). Nuclear Phys. 9, 577-84(1959) Jan. (2).

A simple approximation is described for the calculation of quasi-free proton-proton scattering using distorted incoming and outgoing waves. The method is applied to Li^7 . The results show that in this light nucleus the refraction by the collective nuclear potential does not destroy the strong connection between the angular correlation of the emerging protons and the momentum distribution of the knocked-out proton in the nuclear shell concerned. (auth)

10436

TOTAL CROSS SECTIONS FOR 910 Mev PROTONS. Margaret E. Law, G. W. Hutchinson, and D. H. White (Univ. of Birmingham, Eng.). Nuclear Phys. 9, 600-14(1959) Jan. (2).

The total cross sections for the interactions of 910 Mev protons with carbon, oxygen, deuterium, and hydrogen have been measured. The values obtained are $\sigma_T(\text{carbon}) = 362.0 \pm 2.4$ mb; $\sigma_T(\text{oxygen}) = 469 \pm 10$ mb; $\sigma_T(\text{deuterium}) = 79.1 \pm 1.0$ mb; $\sigma_T(\text{proton}) = 46.1 \pm 0.5$ mb and $\sigma_T(\text{"neutron"}) = 33.0 \pm 0.9$ mb, where the apostrophes indicate that the neutron was bound in the deuteron. When allowance is made for this, a corrected value of $\sigma_T(\text{neutron}) = 39.2 \pm 3.1$ mb is obtained. (auth)

10437

THE SPIN-ORBIT INTERACTION IN NUCLEI. T. H. R. Skyrme (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys. **9**, 635-40(1959) Jan. (2).

The analysis previously made of the average nuclear potential has been extended to consideration of the spin-orbit interactions. It has not been possible to find a satisfactory two-body interaction consistent with all the data; that suggested by the phase-shift analysis of nucleon-nucleon scattering is just within the region of possible forms. (auth)

10438

A $0^+ \rightarrow 0^+$ TRANSITION IN Ce^{140} . B. S. Dzelepov, Yu. V. Kholnov, and V. P. Prikhodtseva (V. G. Khlopin Radium Inst., USSR Academy of Sciences, Leningrad). Nuclear Phys. **9**, 665-9(1959) Jan. (2).

A search has been made for gamma-quanta of energy ≈ 1900 kev in the spectrum of La^{140} by means of a gamma-spectrometer by analysis of recoil electrons. It is shown that if such exist, their intensity is $< 0.4 \times 10^{-3}$ quantum per disintegration. It is simultaneously confirmed that the spectrum of conversion electrons contains intense conversion lines corresponding to a transition energy of 1902 kev. The lower limit of the conversion coefficient of this transition proved equal to 0.38. Such a large value of this limit indicates that it is either a transition of high multipole order ($l > 10$), or a $0^+ \rightarrow 0^+$ transition in which gamma quanta of the given energy are entirely absent. The first assumption may be discarded since in this case the lifetime of the 1900 kev state should be very great ($> 10^{10}$ years), whereas, the intensity of the corresponding conversion line falls off with a half life of ≈ 40 hours. We are thus dealing here with a new $0^+ \rightarrow 0^+$ transition. The characteristics of several other transitions in Ce^{140} are discussed. (auth)

10439

THE DISINTEGRATION OF Ga^{73} . L. Marquez, E. W. Cybulska, N. L. Costa, and I. G. Almeida (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro) and J. Goldemberg (Universidade de São Paulo, Brazil). Nuclear Phys. **10**, 28-32(1959) Feb. (1)

The disintegration of Ga^{73} was studied using gamma ray spectrometers, both alone and in coincidence, and by the absorption of the beta rays in coincidence with the most prominent gamma ray in the scintillation spectrometer. It was found that there were two gamma rays: one with an energy of 310 kev and intensity of about 90% and one with an energy of 740 kev and an intensity of about 7%. A self-consistent decay scheme is proposed showing one beta ray of 550 kev and intensity of about 7%, one beta ray of 1300 kev and intensity of about 83% and perhaps a third beta ray of 1600 kev and intensity of about 10%. All the beta rays lead to the metastable state of Ge^{73} . (auth)

10440

ON THE HALF-LIFE OF Ti^{264} . Richard W. Fink (Univ. of Arkansas, Fayetteville) and Berol L. Robinson (Western Reserve Univ., Cleveland). Nuclear Phys. **10**, 82-7(1959) Feb. (1)

Samples of Ti^{264} produced in different irradiations and of varying ages were counted in an end-window methane-flow beta-proportional counter for a period of 1.4 years. The decay curves for these samples are identical, and the average value of the half-life is

3.78 ± 0.04 years. Intercomparison of the ratio of K x rays to beta-bremsstrahlung and of L x rays to beta-bremsstrahlung between young (few months) and aged (6 years) reactor-produced, high specific activity solutions of Ti^{264} exhibited no differences which might arise from the presence of a long-lived isomeric state in thallium. Previous results are summarized. (auth)

10441

CIRCULAR POLARIZATION OF GAMMA RAYS FOLLOWING THE EMISSION OF POLARIZED HEAVY PARTICLES. J. Zimányi (Central Research Inst. of Physics, Budapest). Nuclear Phys. **10**, 88-91(1959) Feb. (1)

The circular polarization of gamma rays following the emission of heavy particles was calculated. It was found that the circular polarization of gamma rays is proportional to the polarization of the emitted heavy particles. Correlation between the two polarizations can be expressed by known functions of essentially geometrical nature. (auth)

10442

MEASUREMENTS OF THE γ -RADIATIONS FROM Eu^{152} BY THE METHOD OF EXTERNAL CONVERSION. Ove Nathan and Sölve Hultberg (Nobel Inst. of Physics, Stockholm). Nuclear Phys. **10**, 118-34(1959) Feb. (2)

The photoline spectrum from 10 γ rays following the decay of $12 \text{ y } \text{Eu}^{152}$ was studied with a double-focusing β spectrometer, using a 2.2 mg/cm^2 U converter. The resulting momentum resolution was 0.6 to 1%, depending on energy. The relative γ -ray intensities found are in good agreement with those obtained by Dzelepov and Zhukovsky from a study of recoil electrons. Combining our γ -ray intensities and the internal conversion data of Bobykin and Novik, relative values of internal conversion coefficients of the investigated γ -rays were determined. The multipolarity assignments obtained in this way are discussed within the framework of the unified model, and particular attention is given to the 689 kev transition in Sm^{152} . It is suggested that this radiation is of the $E0 + E2$ type and is proceeding from a proposed $2 + \beta$ -vibrational state at 811 kev to the $2+$ member of the ground-state rotational band. The decay properties of the 811 kev state are discussed in some detail. (auth)

10443

NUCLEAR RAMAN EFFECT. Z. Marić and P. Möbius (Univ. of Copenhagen). Nuclear Phys. **10**, 135-9(1959) Feb. (2)

The dependence of the photo-effect on nuclear orientation is discussed. The cross-section for the excitation of rotational states in nonelastic γ scattering by deformed nuclei is computed. (auth)

10444

A REMARK ON THE INTERPRETATION OF THE ELECTRON-NUCLEUS SCATTERING EXPERIMENTS. C. Villi (Univ. of Trieste and Istituto Nazionale di Fisica Nucleare, Trieste). Nuclear Phys. **10**, 166-80(1959) Feb. (2)

The consequences on the interpretation of the electron-nucleus scattering data, arising from the finite size of the proton and/or of the electron, are discussed. (auth)

10445

INELASTIC SCATTERING OF COLD NEUTRONS FROM SEVERAL HYDROGENOUS LIQUIDS. R. M. Brugger,

L. W. McClellan, G. B. Streetman, and J. E. Evans (Phillips Petroleum Co., Idaho Falls, Idaho). Nuclear Sci. and Eng. 5, 99-104(1959) Feb.

A new spinning sample method was used to measure the energies of beryllium-filtered neutrons scattered at 90° to the beam by samples of water, ethyl alcohol, n-amyl alcohol, benzene, paraffin, and zirconium hydride. The energy distributions from all samples show that an appreciable number of scattered neutrons gain energy. The zirconium hydride and water were measured to compare the spinning sample method with other methods of measuring inelastic scattering. The hydrogenous liquids were investigated to see if the scattering data could be correlated with known molecular properties and with proposed scattering theories. (auth)

10446

SMALL ANGLE SCATTERING OF 970 Mev PROTONS FROM CARBON. C. J. Batty, P. J. Duke, S. J. Goldsack, and W. O. Lock (Univ. of Birmingham, Eng.). Nuovo cimento (10) 9, Suppl. No. 2, 369-71(1958).

The differential cross section for the scattering at small angles of 970-Mev protons from carbon was measured in order to examine the interference between the Coulomb and nuclear parts of the scattering at this energy. The measurements were made at laboratory angles from 1 to 3.75° . The proton beam of the Birmingham synchrotron was scattered from a carbon target placed inside a vacuum box. (W.D.M.)

10447

ANGULAR DISTRIBUTIONS OF NEUTRONS PRODUCED IN THE REACTION $\text{Li}^7(d,n)\text{Be}^8$. J. Catalá, R. Font, F. Senent, J. Aguilar, and M. de la Cuadra (Instituto de Optica "Daza de Valdes," Valencia). Nuovo cimento (10) 9, Suppl. No. 2, 377-80(1958). (In Spanish)

A target of Li^7 , isotopically pure, was bombarded with 1080-kev deuterons, and the angular distribution of the neutrons was determined with the use of nuclear emulsions. A study of the spectral distribution of the neutrons showed the existence of the following excited states of Be^8 : 1.37, 2.09, 2.81, 3.52, 4.20, 5.01, 5.91, and 6.68 Mev. The differential cross section for each excited state and the total cross section for the reaction corresponding to each of the excited levels were calculated. (J.S.R.)

10448

EXAMPLES OF DIRECT EMISSION OF β -RAYS AFTER CAPTURE OF A μ -MESON BY AN ARGON NUCLEUS. R. A. Donald and G. R. Evans (Univ. of Edinburgh). Nuovo cimento (10) 9, Suppl. No. 2, 385-9(1958).

Among photographs of cosmic rays obtained with a Wilson cloud chamber filled with argon at 75 atmospheres, three examples were found of particles identified as μ mesons, stopping in the chamber and subsequently emitting β rays of approximately 2.8-Mev energy. From the number of identified μ -e decays, the positive excess of μ -mesons, and the capture probability for negative μ -mesons in argon, is calculated at approximately 35 stopped μ -mesons are contained in the photographs in question. It is most unlikely that the events can be normal μ -e decays since very few decay electrons fall in the energy band 0-5 Mev. The Michel spectrum products that, on average, less than 0.03 such decays would be observed for the conditions of the experiment. (W.D.M.)

10449

GENERALIZED DISPERSION RELATIONS. A. A. Logunov and A. N. Tavkhelidze (Joint Inst. for Nuclear Research, Moscow). Nuovo cimento (10) 10, 943-52 (1958) Dec. 16.

General dispersion relations for reactions $a + b \rightarrow a' + c + d$ were obtained. The possible cases of $(\gamma + p \rightarrow 2\gamma + p)$ scattering are indicated, for which dispersion relations do not contain unobservable range of energy. (auth)

10450

ON THE THEORY OF DISPERSION RELATIONS. A. A. Logunov, S. M. Bilenkij, and A. N. Tavkhelidze (Joint Inst. for Nuclear Research, Moscow). Nuovo cimento (10) 10, 953-64(1958) Dec. 16.

The dispersion relations for the double Compton-effect in the case of absence of unobservable energy region are proved. (auth)

10451

CALCULATION OF THE QUADRUPOLE MOMENTS OF ATOMIC NUCLEI IN THE NILSSON SCHEME.

D. Bogdan (Inst. de Physique Atomique, Bucharest). Nuovo cimento (10) 10, 985-93(1958) Dec. 16. (In French)

The mean value of the operator $e \sum r_i^2 Y_{2,0}(\theta_i, \varphi_i)$, corresponding to a system of protons which are moving independently in the deformed nuclear field, was calculated. The wave function of the nucleus is written in the approximation where it is considered that the rotational movement of the nuclear field does not influence the individual movements of the nucleons. For the "individual" part of the wave function, the product of two Slater determinants (one for protons and the other for neutrons), formed by the single nucleon wave functions given by the Nilsson model, was used. The calculations were made in the representation which takes away the coupling between the states with differing N , as well as in the representation which considers the coupling. The comparison with the experimental values of the nuclear quadrupole moments for odd nuclei which are in the region $150 < A < 188$ shows that the use of the last representation is indispensable. (tr-auth)

10452

ON THE MECHANISM OF THE $(n, 2n)$ REACTION AT 14 Mev NEUTRON ENERGY. IL. K. Winter, B. Torki, and E. Remy (Collège de France, Paris). Nuovo cimento (10) 11, 1-11(1959) Jan. 1.

The correlation of the respective directions of emission of the two neutrons in the $\text{Be}^9(n, 2n)\text{Be}^8$ reaction was investigated by using coincidence detection of the outgoing neutrons. In an azimuthal plane, separation angles ranging from 45° to 90° are predominant; a maximum correlation of $(20 \pm 3)\%$ is obtained at 60° . This angular correlation is attributed to simultaneous emission of two neutrons. Angular distribution measurements on the same reaction proved, by using time-of-flight techniques, that second neutrons are emitted by a compound nucleus, whereas first neutrons are emitted both directly and by a compound nucleus. (auth)

10453

RADIO-FREQUENCY SPECTRA OF HYDROGEN DEUTERIDE IN STRONG MAGNETIC FIELDS. W. E. Quinn, J. M. Baker, J. T. LaTourette, and N. F.

Ramsey (Harvard Univ., Cambridge, Mass.). *Phys. Rev.* **112**, 1929-40(1958) Dec. 15.

Molecular beam observations were made of the radio-frequency spectra corresponding to reorientations of the deuteron, proton, and rotational magnetic moments in the HD molecule. For HD in the zeroth vibrational and first rotational state, these observations were made in magnetic fields of approximately 1700, 3400, and 4800 gauss. The results are found to be consistent with the theory of heteronuclear diatomic molecules. The direct result of these experiments is the determination of the Hamiltonian interaction constants: $(1-\sigma_1)b/\nu_d$ equals 0.773527 ± 0.000016 , c_p is $85\,600 \pm 18$ cps, c_d equals $13\,122 \pm 11$ cps, d_1 is $17\,761 \pm 12$ cps, d_2 equals $22\,454 \pm 6$ cps, and f/h^2 is $(-26.90 \pm 0.40) \times 10^{-6}$ cps gauss $^{-2}$. From these values of the interaction constants are derived the following physical quantities: the HD rotational magnetic moment $HD[\mu_J/J]_1$ equals 0.663211 ± 0.000014 nuclear magneton, the quadrupole moment Q of the deuteron is $(2.738 \pm 0.014) \times 10^{-27}$ cm 2 , the rotational magnetic field H'_p at the proton is 19.879 ± 0.006 gauss and H'_d at the deuteron is 20.020 ± 0.028 gauss, the internuclear spacing in the zeroth vibrational and first rotational state is such that $HD[R^{-3}]_1^{-1/2}$ equals $(0.74604 \pm 0.00010) \times 10^{-8}$ cm, and the dependence of the diamagnetic susceptibility on molecular orientation $(\xi_{\pm 1} - \xi_0)$ is $-(3.56 \pm 0.20) \times 10^{-31}$ erg gauss $^{-2}$ molecule $^{-1}$. Combining these values with Ramsey's theory on zero-point vibration and centrifugal stretching in molecules gives the high-frequency contribution to the molecular susceptibility, $HD[\xi^{hf}]_1 = (1.675 \pm 0.005) \times 10^{-31}$ erg gauss $^{-2}$ molecule $^{-1}$; the quadrupole moment of the electron distribution relative to the internuclear axis, $HD[Q_e]_1 = (0.324 \pm 0.010) \times 10^{-18}$ cm 2 ; and the high-frequency contribution to the magnetic shielding constant for HD, $HD[\sigma^{hf}]_1 = (-0.594 \pm 0.030) \times 10^{-5}$. (auth)

10454

TWO NEW PROMETHIUM ISOTOPES: CROSS SECTIONS OF SOME SAMARIUM ISOTOPES FOR 14.8-Mev NEUTRONS. R. G. Wille and R. W. Fink (Univ. of Arkansas, Fayetteville). *Phys. Rev.* **112**, 1950-4(1958) Dec. 15.

When highly enriched samples of Sm^{152} and Sm^{154} are irradiated with 14.8-Mev neutrons, activities having half-lives of 6.5 ± 0.5 min and 2.5 ± 0.5 min are observed. On the basis of yields and cross-bombardments, these are assigned to new isotopes Pm^{152} and Pm^{154} , respectively. Cross-section measurements at 14.8 Mev for $(n,2n)$, (n,p) , and (n,α) reactions of samarium are reported, the experimental values being as follows: $Sm^{144}(n,2n)$, 1200 ± 300 mb; $Sm^{154}(n,2n)$, 1500 ± 300 mb; $Sm^{152}(n,p)$, 3.7 ± 0.2 mb; $Sm^{154}(n,p)$, 3.5 ± 0.2 mb; $Sm^{152}(n,\alpha)$, 10 ± 2 mb; and $Sm^{154}(n,\alpha)$, 9 ± 3 mb. While the $(n,2n)$ cross sections are within an order-of-magnitude agreement with statistical evaporation theory, the experimental values for the (n,p) and (n,α) cross sections are several orders of magnitude larger than those calculated from statistical evaporation theory based on the compound nucleus model. (auth)

10455

NEW GERMANIUM ISOTOPE, Ge^{65} . Norbert T. Porile (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **112**, 1954-8(1958) Dec. 15.

A new germanium isotope, Ge^{65} , was produced by the $(\alpha,3n)$ reaction on Zn^{64} . The mass assignment was established through cross bombardments, "milkling"

experiments, and excitation function measurements. The half-life of Ge^{65} is 1.5 ± 0.2 minutes. It decays by positron emission to 15-minute Ge^{65} . The ground-state transition occurs in over 90% of the disintegrations and has a positron end-point energy of 3.7 ± 0.4 Mev and a $\log(ft)$ value of 4.8. Gamma rays of 0.67 Mev and 1.72 Mev have been observed with intensities of $0.03/\beta^+$ and $0.02/\beta^+$, respectively. (auth)

10456

FIVE NEW ISOMERS WITH HALF-LIVES BETWEEN 10^{-6} AND 10^{-1} SECOND. Robert B. Duffield and Stanley H. Vegors, Jr. (Univ. of Illinois, Urbana). *Phys. Rev.* **112**, 1958-71(1958) Dec. 15.

Isomers with half lives greater than approximately 5 μ sec were sought between the 180-cps, 1- μ sec x-ray pulses of a 22-Mev betatron. New activities were observed in Br^{78-80} , Br^{79-81} , Nb^{92} , In^{114} , and Sn . Half lives, gamma energies, and production reactions and thresholds are tabulated. Excitation function and cross sections for production are also given for some cases. The properties of all the isomers investigated are summarized. Additional results include improved values for half lives and gamma-ray energies, production thresholds, excitation functions, and cross sections for the isomers previously reported. (A.C.)

10457

DECAY OF Ca^{39} . O. C. Kistner and B. H. Rustad (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **112**, 1972-5(1958) Dec. 15.

The "doubly closed shell \pm one nucleon" mirror transition, $Ca^{39}(\beta^+)K^{39}$, was investigated in order to obtain a more precise ft value. The beta spectrum was measured with a magnetic, thin-lens spectrometer and has a maximum energy of 5.490 ± 0.025 Mev. A search for gamma rays was made with a NaI(Tl) scintillation spectrometer, and an upper limit of 0.12% was placed on transitions to the lowest known excited levels in K^{39} between 2.5 and 3.5 Mev. A half-life of 0.88 ± 0.01 second was determined. The ft value calculated from these results is 4320 ± 100 seconds. (auth)

10458

$N^{14}(d,n)O^{15}$ AND $N^{15}(d,n)O^{16}$ REACTIONS. J. L. Weil and K. W. Jones (Columbia Univ., New York). *Phys. Rev.* **112**, 1975-81(1958) Dec. 15.

Absolute cross sections for the $N^{14}(d,n)O^{15}$ and $N^{15}(d,n)O^{16}$ reactions were measured at zero degrees to the incident deuteron beam from 0.6 to 5.3 Mev bombarding energy. Both excitation curves show strong resonance structure and have maximum cross sections of about 6 mb per steradian. Eight angular distributions were measured for the $N^{15}(d,n)O^{16}$ reaction at points on and off maxima in the excitation curve. A good fit to the angular distributions is obtained by use of the exchange stripping theory of Owen and Madansky. (auth)

10459

PHOTOEXCITATION OF Pb^{201m} . U. Farinelli, F. Ferrero, R. Malvano, S. Menardi, and E. Silva (Univ. of Turin and Istituto Nazionale di Fisica Nucleare, Turin). *Phys. Rev.* **112**, 1994-8(1958) Dec. 15.

The 0.8-sec isomeric activity in lead was excited by the photoneutron reaction in Pb^{208} and the relative cross section was calculated from the measured yield. The cross section presents an extremely sharp peak in the giant resonance region with half-width not

greater than 2 Mev. The isomeric level excitation efficiency, $\sigma(\gamma, n^*)/\sigma(\gamma, n)$, was calculated: it reaches a maximum value of 5%, which may be compared with the same quantity relative to inelastic neutron scattering in Pb^{207} , that already at the energy of 11 Mev, in the compound system, assumes a 14% value. A discussion is given to explain the complete disagreement between the above two values of the excitation efficiency, which is attributed to the difference in angular momentum transferred to the compound system in the above two reactions. (auth)

10460

POSITRON SPECTRA OF Eu^{152} AND Eu^{152m} . D. E. Alburger, S. Ofer, and M. Goldhaber (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **112**, 1998-2003(1958) Dec. 15.

An intermediate-image beta-ray spectrometer equipped with spiral baffles was used to investigate positrons in the decays of Eu^{152} and Eu^{152m} . Thirteen-year Eu^{152} emits a positron group to the 0.122-Mev 2+ first excited state of Sm^{152} with an end-point energy of 0.715 ± 0.010 Mev and an intensity of 1.6×10^{-4} per disintegration (log ft = 11.9) and a positron group to the 0.366-Mev 4+ second excited state with an end point of 0.47 ± 0.03 Mev and an intensity of 0.8×10^{-4} per disintegration (log ft = 11.5). 9.3-hr Eu^{152m} emits a positron group to the ground state of Sm^{152} with an end-point energy of 0.895 ± 0.005 Mev and an intensity of 7×10^{-6} per disintegration (log ft = 8.65) and a positron group to the 0.122-Mev state with an intensity of 4×10^{-6} per disintegration (log ft = 8.6). The shape of the latter group has not been established. However, its end point, when the alpha shape factor is applied, gives better agreement with the 0.122-Mev energy separation from the ground-state beta ray than the end point of the uncorrected spectrum. The result is consistent with, but not positive proof of, the assumed spin of 0- for Eu^{152m} . The β^- end-point energies of Eu^{152} and Eu^{152m} are 1.470 ± 0.010 Mev and 1.855 ± 0.010 Mev, respectively. An energy separation of 0.050 ± 0.015 Mev between Eu^{152m} and Eu^{152} is derived from the various β^+ and β^- end-point measurements. No L-conversion electrons could be found in Eu^{152m} decay corresponding to a 0.05-Mev isomeric transition. An upper limit of 3×10^{-6} per disintegration was obtained for the fractional decay of Eu^{154} by positron emission. (auth)

10461

SCATTERING OF 18.7-Mev ALPHA PARTICLES FROM Al, Cu, AND Ag. O. H. Gailar, E. Blueier, and D. J. Tendam (Purdue Univ., Lafayette, Ind.). *Phys. Rev.* **112**, 1989-93(1958) Dec. 15.

The scattering of 18.7-Mev alpha particles from Ag, Cu, and Al was studied from 10° to 170° with rms angular resolutions of 0.4° to 0.85° . The scattered alpha particles were separated from singly charged reaction products with the aid of a proportional counter, and their energies were measured with a CsI(Tl) scintillation spectrometer. The elastic scattering for Ag shows the "exponential" dropoff from the Coulomb cross section, without any pronounced structure at large angles. For Cu, definite changes in the slope of the dropoff are observed up to 120° , followed by a shallow minimum near 130° and a very deep, narrow minimum at 162° (cm). The interaction radii deduced from the strong-absorption model agree with those found at higher energies. From the diffraction-

like pattern found for Al, an interaction radius of 6.4×10^{-13} cm is derived, appreciably larger than the one obtained at 40 Mev (5.4×10^{-13} cm). There are indications that a direct-process interpretation of the inelastic scattering from Al is possible. (auth)

10462

SMALL DEVIATIONS OBSERVED IN BETA SPECTRA: In^{114} , Y^{90} , AND P^{32} . O. E. Johnson, R. G. Johnson, and L. M. Langer (Indiana Univ., Bloomington). *Phys. Rev.* **112**, 2004-9(1958) Dec. 15.

The beta spectra of In^{114} , Y^{90} , and P^{32} (all of which decay by pure Gamow-Teller radiations) were very carefully studied in a magnetic spectrometer. The Fermi-Kurie plots of all three spectra exhibit small deviations from linearity corresponding to an excess of low-energy electrons. All of the evidence indicates that the observed nonstatistical shapes represent the true spectra and are not the result of instrumental distortions. The Fermi-Kurie plots of these three isotopes can be linearized by a $(1 + b/W)$ correction factor (in addition to the once-forbidden, unique shape factor in the case of Y^{90}). (auth)

10463

SMALL DEVIATIONS OBSERVED IN BETA SPECTRA: Na^{22} . J. H. Hamilton, L. M. Langer, and W. G. Smith (Indiana Univ., Bloomington). *Phys. Rev.* **112**, 2010-19(1958) Dec. 15.

The intense positron spectrum of Na^{22} was carefully measured in a magnetic spectrometer. This transition proceeds from a 3+ to a 2+ level. The observed Na^{22} spectrum has a nonstatistical shape corresponding to an excess of low-energy electrons. The well-measured spectrum of Pm^{147} was reinvestigated and found to have a statistical shape. The many tests of the experimental procedures all indicate that the observed nonstatistical spectrum of Na^{22} is not the result of instrumental distortions. Theoretical refinements for finite de Broglie wavelength, screening, and possible contributions from the twice forbidden matrix elements were considered and found to be much too small to explain the deviation from the statistical shape observed in Na^{22} . The Fermi-Kurie plot of Na^{22} can be linearized by a $(1 + b/W)$ correction factor. This same factor has been used to linearize the Fermi-Kurie plots of In^{114} , Y^{90} , and P^{32} (in addition to the once forbidden, unique shape factor in the case of Y^{90}). In all four cases, the value of the parameter b to yield a linear F-K plot is in the range $0.2 < b < 0.4$. At present, no theoretical explanation is offered for the correction $(1 + b/W)$. It may be regarded as an empirical correction capable of explaining the observed shapes in the case of these four Gamow-Teller transitions. A search was also made for negative electrons accompanying the normal positron decay of Na^{22} . A weak, low-energy electron distribution was observed. This distribution may be explained by the theory of "shake-off" electrons. (auth)

10464

ANGULAR DISTRIBUTIONS FROM DEUTERON BOMBARDMENT OF BERYLLIUM AND BORON. B. Zeldman and J. M. Fowler (Washington Univ., St. Louis). *Phys. Rev.* **112**, 2020-6(1958) Dec. 15.

The angular distributions, from 10° to 160° , of the emergent particles from the reactions $\text{Be}^9(d,p)\text{Be}^{10}$, $\text{Be}^{10}(d,p)\text{Be}^{11}$, and $\text{B}^{11}(d,n)\text{C}^{12}$ were investigated. The proton distributions were obtained at incident deuteron energies of 10, 9.2, and 8.1 Mev while the neutron distributions were obtained with 10-Mev deuterons. The

proton distributions are analyzed using the Butler theory of deuteron stripping and, with the exception of the distributions from B^{11*} , are in agreement with $l_n = 1$ at forward angles. The distributions from the first excited state of B^{11} are not in agreement with any curves based upon the Butler theory, indicating that stripping does not play a major part in this reaction. The neutron distributions are analyzed using the treatment of Owen and Madansky, which allows heavy-particle stripping as well as Butler stripping. Reasonable agreement between the data and this theory for the ground state is obtained by using approximately equal amplitudes for Butler and exchange stripping and angular momenta of $l = 1$ and $l = 0$, respectively, for deuteron and exchange stripping. The analysis of the distribution for the first excited state of C^{13} shows $l = 1$ for deuteron stripping, but does not provide a unique choice for the angular momentum in exchange stripping. (auth)

10465

INTERNAL CONVERSION ELECTRONS FROM COULOMB EXCITATION OF Ta^{181} . E. M. Bernstein (Duke Univ., Durham, N. C. and Univ. of Wisconsin, Madison). *Phys. Rev.* **112**, 2026-8(1958) Dec. 15.

The conversion electron spectrum following Coulomb excitation of Ta^{181} has been remeasured with greater accuracy. The results are internally consistent with the rotational model of Bohr and Mottleson and are in excellent agreement with the gamma-ray angular distribution and yield data of McGowan and Stelson. (auth)

10466

INELASTIC SCATTERING FROM LIGHT NUCLEI—THE ALPHA-PARTICLE MODEL FOR Be^8 . J. S. Blair (Princeton Univ., N. J.) and E. M. Henley (Univ. of Washington, Seattle). *Phys. Rev.* **112**, 2029-42(1958) Dec. 15.

The inelastic scattering of nucleons, deuterons, and alpha particles from light nuclei is discussed in terms of direct interactions. The validity of this description, and of the approximations made in calculating cross sections, are analyzed in detail. Physical arguments are given for the use of a collective representation of light nuclei, in order to explain the preferential excitation of certain well-defined nuclear states by short-wavelength projectiles. As an example, the alpha-particle model is used to characterize Be^8 and the inelastic cross sections for excitation of rotational, vibrational, and single-particle states are calculated with an impulse approximation. The model, and results computed from it, are examined and compared to experimental findings. (auth)

10467

SCATTERING OF PROTONS FROM HELIUM AND LEVEL PARAMETERS IN Li^6 . Philip D. Miller and G. C. Phillips (Rice Inst., Houston, Texas). *Phys. Rev.* **112**, 2043-7(1958) Dec. 15.

The scattering of protons from helium was investigated experimentally from 2.0 to 5.5 Mev with the Rice Institute Van de Graaff accelerator and a differentially pumped, large-volume scattering chamber. Excitation curves reveal no new states in Li^6 up to an excitation energy of 6.5 Mev. A phase-shift analysis was made of the angular distributions at laboratory bombarding energies of 3.03, 3.51, 4.02, 4.50, and 5.00 Mev. The phase shifts derived from this experiment and from experiments at other laboratories, in the energy range 1 to 18 Mev, have been interpreted in terms of the dispersion theory, and level parameters were extracted.

The nuclear radius which best fits the P-wave phase shifts is 2.6×10^{-13} cm. For the ground state, $(E_{res})_{lab} = 2.6$ Mev, $J = \frac{3}{2}^-$, $\gamma_p^2 = 12 \times 10^{-13}$ Mev-cm, and $\theta_p^2 = 0.40$. For the first excited state, $(E_{res})_{lab} = 10.8$ Mev, $J = \frac{1}{2}^-$, $\gamma_p^2 = 30 \times 10^{-13}$ Mev-cm, and $\theta_p^2 = 1.0$. The S-wave phase shift is moderately well fit by a hard-sphere interaction with a radius of 2.0×10^{-13} cm. At the present time, the D-wave phase shifts are so inaccurately known, that very little interpretation is possible. (auth)

10468

SCATTERING OF He^3 FROM He^4 AND STATES IN Be^7 . Philip D. Miller and G. C. Phillips (Rice Inst., Houston, Texas). *Phys. Rev.* **112**, 2048-52(1958) Dec. 15.

The range of excitation energies in Be^7 from 3.28 to 4.73 Mev was investigated by Van de Graaff-accelerated He^{3+} ions scattered from He^4 gas in a differentially pumped, large-volume scattering chamber. The second excited state in Be^7 was studied, and its laboratory resonant energy and width were determined to be 5.17 Mev and 0.180 Mev, respectively, corresponding to an excitation energy in Be^7 of 4.53 ± 0.02 Mev and a center-of-mass width of 0.102 Mev. The spin and parity are $J = \frac{7}{2}^-$ and the reduced width is 3.0×10^{-13} Mev-cm. The behavior of the nonresonant phase shifts is shown to be qualitatively consistent with other known states in Be^7 , whose resonant energies lie outside the range of the present experiment. (auth)

10469

PRODUCTION OF HELIUM IN IRON METEORITES BY THE ACTION OF COSMIC RAYS. John H. Hoffman and Alfred O. Nier (Univ. of Minnesota, Minneapolis). *Phys. Rev.* **112**, 2112-17(1958) Dec. 15.

The helium distribution in a slice from the iron meteorite, Grant, was measured and plotted in the form of contour maps. The contours of constant helium show a minimum helium content and isotopic ratio, He^3/He^4 , near the center of the slice, the isotopic ratio varying from 0.26 near the center to 0.30 at the surface. A cosmogenic helium production rate equation was fitted to the data giving a He^3/He^4 production ratio by primary cosmic rays of 0.50 and by secondary particles of 0.14. Primary and secondary particle interaction cross sections were found to be 540 mb and 720 mb, respectively. The ratio of the average post-atmospheric radius to the pre-atmospheric radius of Grant was calculated to be 0.65. (auth)

10470

LENGTH AND RESISTIVITY CHANGES IN GERMANIUM UPON LOW-TEMPERATURE DEUTERON IRRADIATION AND ANNEALING. Frederick L. Vook and R. W. Balluffi (Univ. of Illinois, Urbana). *Phys. Rev.* **113**, 62-9(1959) Jan. 1.

Simultaneous measurements of the length change and resistivity of high-purity germanium single crystals were made upon irradiation and annealing. The specimens were initially irradiated at 25°K with deuterons of average energy 10.2 Mev to an integrated flux of 6.2×10^{16} deuterons/cm² and annealed to room temperature. The specimens were then irradiated at 85°K to an additional flux of 9.2×10^{16} deuterons/cm² and annealed to 364°K. (auth)

10471

LATTICE PARAMETER CHANGES IN DEUTERON-IRRADIATED GERMANIUM. R. O. Simmons (Univ. of Illinois, Urbana). *Phys. Rev.* **113**, 70-1(1959) Jan. 1.

A lattice expansion of 3×10^{-5} was measured in germanium irradiated by 1.5×10^{17} 9-Mev deuterons/cm²

at low temperature and annealed to 320°K. Thus residual specimen length expansion and lattice parameter expansion are small and nearly equal after annealing to room temperature. Thermal recovery to 380°K occurred parallel to that of macroscopic length changes, but near 380°K the (211) interplanar spacing had contracted about 3×10^{-5} relative to unirradiated crystal. The lattice parameter returned to that of unirradiated crystal at 430°K. No appreciable diffraction line broadening was observed. These results provide confirmatory evidence that structural damage in deuteron-irradiated germanium consists of well-localized centers of dilatation. (auth)

10472

STRUCTURE OF DEUTERON-IRRADIATED GERMANIUM. Frederick L. Vook and R. W. Balluffi (Univ. of Illinois, Urbana). *Phys. Rev.* **113**, 72-8(1959) Jan. 1.

The structure of deuteron-irradiated germanium is discussed in the light of the following recent experiments: (1) simultaneous measurements of the change in length and resistivity upon low temperature bombardment and annealing, (2) measurement of lattice parameter changes after annealing near room temperature, and (3) low-angle x-ray scattering measurements at liquid nitrogen temperature and above. A model of the damage at liquid nitrogen temperature consisting of separated clusters of vacancies and interstitials, is proposed. The model yields a comparatively small length increase and fairly strong low-angle x-ray scattering in agreement with experiment. The model also appears capable of explaining the experimental observation that resistivity annealing occurs in an earlier stage of the recovery process than appreciable length-change annealing. The clusters must be formed, at or below liquid nitrogen temperature, either by diffusive motion of the defects or by displacement processes directly upon bombardment. If the latter mechanism holds, present theory greatly underestimates displacement distances in germanium. Additional critical experiments are proposed. (auth)

10473

NUCLEAR STRUCTURE CORRECTION TO THE HYPERFINE STRUCTURE IN HYDROGEN. C. K. Iddings and P. M. Platzman (California Inst. of Tech., Pasadena). *Phys. Rev.* **113**, 192-7(1959) Jan. 1.

The proton is treated as a particle with structure by making use of the high-energy electron-proton-scattering data. Corrections of the previous work in which only a point particle was considered are calculated by using the Feynman formulation of quantum electrodynamics. It is also shown that exactly the same terms may be obtained by using the covariant Bethe-Salpeter equation. The calculated shift of -35 parts per million is not in agreement with the combined results of several experiments (-1.4 ± 18 parts per million). A possible source of this difference is meson corrections to a two-photon form-factor which is taken here as the product of two single-photon form-factors. (auth)

10474

CLASSIFICATION OF THE ENERGY LEVELS OF ODD-MASS NUCLEI IN THE HEAVY-ELEMENT REGION. F. S. Stephens, Frank Asaro, and I. Perlman (Univ. of California, Berkeley). *Phys. Rev.* **113**, 212-24(1959) Jan. 1.

Most of the data available on energy levels in odd-mass nuclei of the heaviest elements have been sum-

marized and evaluated. The observed levels were classified according to the level diagrams calculated by Nilsson for nuclei with prolate spheroidal deformations. Qualitatively, the agreement between the data and the Nilsson diagrams is very good. (auth)

10475

TIME REVERSAL IN NUCLEAR INTERACTIONS.

Ernest M. Henley and Boris A. Jacobsohn (Univ. of Washington, Seattle). *Phys. Rev.* **113**, 225-33(1959) Jan. 1.

The limitations imposed by time-reversal invariance of nuclear forces were examined for nuclear reactions, elastic double scattering (polarization) experiments, and angular correlations of gamma rays emitted from unoriented nuclei. For each of these, it was found that certain experiments, which may superficially appear to be sensitive tests of time-reversal invariance, are actually completely or partially insensitive to this symmetry. For example, in certain cases, the unitarity of the S matrix is sufficient to assure detailed balance. Such insensitivity to time-reversal invariance operates in some of the experimentally best-investigated problems. Those experiments which may be expected to be sensitive tests yield an upper limit of about 10% for that fraction of the Hamiltonian which is odd with respect to a time inversion. Experiments are suggested which may lower this limit. (auth)

10476

GAMMA-RAY ANGULAR CORRELATION TESTS FOR TIME-REVERSAL INVARIANCE IN NUCLEAR FORCES. Boris A. Jacobsohn and Ernest M. Henley (Univ. of Washington, Seattle). *Phys. Rev.* **113**, 234-8(1959) Jan. 1.

A systematic method for constructing tests of time-reversal invariance in nuclear forces by means of gamma-ray angular correlations is described. The transition supplying the test consists of a mixed multipole; it must be preceded by a polarizer to produce a nuclear orientation and (in all but one case) followed by a second photon which serves as an analyzer of the final nuclear orientation. The exception is a test in which one detects the linear polarization and direction of a quantum from a nucleus with initial orientation of third degree. A general formula for the direction of a single photon with arbitrary polarization and involving an arbitrary orientation of both the initial and final nuclear states is presented. Expressions of this type have the advantage that individual ones can be combined together in a simple way to form an arbitrary correlation formula. This is carried through numerically in one case for beta-gamma-gamma direction correlation, where the first photon is mixed E2 and M1. It is shown that such measurements must be carried out to 1 or 2% in order to better the present limit of our knowledge concerning time-reversal invariance. (auth)

10477

DECAY SCHEMES OF Sm^{145} AND Pm^{145} . A. R. Brosi, B. H. Ketelle, H. C. Thomas, and R. J. Kerr (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **113**, 239-46(1959) Jan. 1.

The electron capture decay schemes of Sm^{145} and Pm^{145} were investigated. The total disintegration energy of Sm^{145} was found to be 645 ± 15 kev by measurement of the inner bremsstrahlung energy end point. The fraction of electron captures to the 61-kev level that are K-electron captures was computed to be

0.83 ± 0.02 from conversion electron-x-ray coincidence counting rates. The same coincidence method gave 0.54 ± 0.02 as the K-electron capture fraction in Pm^{145} decay to the 67 keV level in Nd^{145} . From the experimental capture ratio the transition energy was computed to be 73 ± 10 keV. The lifetime of the 61-keV level in Pm^{145} was found to be 2.6×10^{-8} sec and that of the 67-keV level in Nd^{145} was found to be 3.3×10^{-8} sec. Conversion coefficients of the gamma rays emitted in Sm^{145} and Pm^{145} decay were measured. Energy level schemes which have spin and parity assignments consistent with the experimental measurements are proposed for both isotopes. (auth)

10478

NEUTRON THRESHOLDS IN THE $\text{V}^{51}(\text{p},\text{n})\text{Cr}^{51}$, $\text{Mn}^{55}(\text{p},\text{n})\text{Fe}^{55}$, $\text{Zn}^{70}(\text{p},\text{n})\text{Ga}^{70}$, AND $\text{As}^{75}(\text{p},\text{n})\text{Se}^{75}$, REACTIONS. C. R. Gossett and J. W. Butler (U. S. Naval Research Lab., Washington). *Phys. Rev.* **113**, 246-51(1959) Jan. 1.

The two-counter slow-to-fast ratio technique was used with proton energies up to about 2 MeV in a study of neutron thresholds from the following four reactions. In the $\text{V}^{51}(\text{p},\text{n})\text{Cr}^{51}$ reaction, the ground-state threshold was measured to be 1.564 ± 0.002 MeV. No excited states were observed in the region of excitation from zero to 0.41 MeV. In the $\text{Mn}^{55}(\text{p},\text{n})\text{Fe}^{55}$ reaction, the ground-state threshold was measured to be 1.034 ± 0.002 MeV. Excited-state thresholds were found at 1.455 ± 0.003 and 1.982 ± 0.002 MeV, corresponding to energy levels in Fe^{55} at 0.414 ± 0.003 and 0.931 ± 0.002 MeV, respectively. In the $\text{Zn}^{70}(\text{p},\text{n})\text{Ga}^{70}$ reaction, the ground-state threshold was measured to be 1.457 ± 0.002 MeV. No excited states were observed in the region of excitation from zero to 0.53 MeV. In the $\text{As}^{75}(\text{p},\text{n})\text{Se}^{75}$ reaction, the ground-state threshold was measured to be 1.669 ± 0.002 MeV. An excited state threshold was found at 1.960 ± 0.002 MeV, corresponding to an energy level in Se^{75} at 0.287 ± 0.002 MeV. A two-counter detector of high sensitivity and a low-background experimental arrangement are described. (auth)

10479

REVISED WEIZSÄCKER SEMIEMPIRICAL FORMULA FOR DIFFUSE NUCLEAR SURFACES. William D. Gunter, Jr. and Robert A. Hubbs (Stanford Univ., Calif.). *Phys. Rev.* **113**, 252-5(1959) Jan. 1.

An attempt is made to modify the Weizsäcker semi-empirical mass formula to include effects of the diffuse nuclear surface indicated by recent electron scattering experiments. Volume and surface effects are combined by integrating over an assumed trapezoidal density function similar to that found experimentally. Good fits to the experimental nuclear masses are achieved with r_0 (a radius parameter) and ϵ (half the surface depth) equal to 1.081×10^{-13} cm and 1.202×10^{-13} cm, respectively. These are in reasonably good agreement with the experimental values (1.07 ± 0.02) $\times 10^{-13}$ cm and $(1.50 \pm 0.20) \times 10^{-13}$ cm found by Hahn, Ravenhall, and Hofstadter. (auth)

10480

(n,γ) CROSS SECTIONS OF Na^{23} , I^{127} , AND Au^{197} . S. J. Bame, Jr. and R. L. Cubitt (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* **113**, 256-8(1959) Jan. 1.

The cross sections for the $\text{Na}^{23}(\text{n},\gamma)\text{Na}^{24}$ and the $\text{I}^{127}(\text{n},\gamma)\text{I}^{128}$ reactions were measured by an activation method over the neutron energy range 20 keV to

1 MeV. The neutron flux was measured with a fission detector which contained a thin layer of known weight of U^{235} . The Na^{23} cross-section variation with energy shows incompletely resolved resonance structure; an average curve through the data decreases as $1/v_n$ from 2.4 mb at 20 keV to 0.6 mb at 300 keV, and as $1/E_n$ from 0.6 mb at 300 keV to 0.2 mb at 1 MeV. The I^{127} cross section can be represented approximately by a straight line on a log-log plot, decreasing from 1.0 barn at 30 keV to 80 mb at 1 MeV. The $\text{Au}^{197}(\text{n},\gamma)\text{Au}^{198}$ cross section, measured at a neutron energy of 180 keV, is 310 ± 20 mb. (auth)

10481

DECAY OF Np^{241} . R. Vandenbosch (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **113**, 259-60(1959) Jan. 1.

The decay of a 16-minute neptunium activity attributed to Np^{241} was studied with anthracene and sodium iodide scintillation counters. The principal mode of decay appears to be a beta group decaying to the ground state of Pu^{241} with a beta end-point energy of 1.36 ± 0.10 MeV. (auth)

10482

ELASTIC SCATTERING OF 21.6-MeV DEUTERONS. J. L. Yntema (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **113**, 261-7(1959) Jan. 1.

The absolute differential cross section for the elastic scattering of 21.6 ± 0.2 MeV deuterons was measured for Mg, Ni, Cu, Zn, Rh, Ag, Pt, and Au. The cross sections were measured for each element with a two-degree interval between 10° and 42° and between 45° and 150° with a five-degree (or less) interval. The estimated standard deviation ranges from 3% in the forward direction to 6% in the backward direction. The deuterons were detected with a double NaI(Tl) crystal with an energy resolution of about 2%. In most cases the contribution of inelastically scattered deuterons to the cross section is negligible. The ratio of measured cross section to Rutherford cross section shows a pronounced diffraction pattern in all cases. (auth)

10483

ENERGY LEVELS IN F^{19} FROM THE $\text{O}^{18}(\text{d},\text{n})\text{F}^{19}$ REACTION. J. W. Butler, L. W. Fagg, and H. D. Holmgren (U. S. Naval Research Lab., Washington). *Phys. Rev.* **113**, 268-72(1959) Jan. 1.

The gamma-ray threshold technique was applied to the $\text{O}^{18}(\text{d},\text{n})\text{F}^{19}$ reaction in the range of deuteron bombarding energies from 1.55 to 3.36 MeV. Four gamma-ray thresholds were observed: 1.85 ± 0.05 , 2.15 ± 0.05 , 2.64 ± 0.03 , and 3.16 ± 0.03 MeV, corresponding to excited states in F^{19} at 7.40 ± 0.05 , 7.67 ± 0.05 , 8.11 ± 0.03 , and 8.58 ± 0.03 MeV, respectively. (auth)

10484

DISINTEGRATION SCHEME OF Zn^{65} . G. I. Gleason (Abbott Labs., Oak Ridge, Tenn.). *Phys. Rev.* **113**, 287-8(1959) Jan. 1.

Spectroscopic-coincidence techniques were employed to re-examine the electron capture rate, branching ratio, and positron rate of Zn^{65} . Decay by positron emission occurs to the extent of $(1.70 \pm 0.10)\%$. Electron capture to the excited state was found to be associated with $(51.3 \pm 3.0)\%$ of the disintegrations, significantly higher than the $(44-46)\%$ reported in previous investigations. (auth)

10485

ABSENCE OF ISOMERISM IN GALLIUM-65. David L. Morrison and Norbert T. Porile (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **113**, 289-90(1959) Jan. 1.

The formation of Ga^{65} was investigated in the decay of Ge^{65} and in the following reactions over a wide range of bombarding energies: $\text{Cu}^{63}(\alpha, 2n)$, $\text{Zn}^{64}(\alpha, p2n)$, $\text{Zn}^{64}(d, n)$, and $\text{Zn}^{64}(p, \gamma)$. In no case was a previously reported 8-minute isomer detected. (auth)

10486

NUCLEAR SPIN SATURATION BY ULTRASONICS IN SODIUM CHLORIDE. E. F. Taylor and N. Bloembergen (Harvard Univ., Cambridge, Mass.). *Phys. Rev.* **113**, 431-8(1959) Jan. 15.

An ultrasonic vibrational mode with rather well-defined properties was set up in a cylindrical single crystal of sodium chloride. The saturation of the spin levels of Na^{23} and Cl^{35} by acoustically induced quadrupole transitions, $\Delta m = \pm 2$, was measured in the steady state by a standard nuclear magnetic resonance technique, for several orientations of the ultrasonic wave and external magnetic fields. The components of the fourth-order tensor connecting the electrical field gradient tensor at the nuclei with the strain deformation tensor were determined. The components satisfy an isotropy condition rather than the Cauchy relation. The results show the inadequacy of the ionic point-charge model coupled with an isotropic Sternheimer antishielding factor. The interpretation of the data requires a considerable amount of covalent character and configurational interaction on the Na^+ ion. (auth)

10487

NUCLEAR REACTIONS INDUCED BY THE NITROGEN BOMBARDMENT OF SULFUR. D. E. Fisher and A. Zucker (Oak Ridge National Lab., Tenn.), and A. Gropp (Univ. of Florida, Gainesville). *Phys. Rev.* **113**, 542-7(1959) Jan. 15.

Thick targets of ZnS , containing natural sulfur, were bombarded with 28-Mev nitrogen ions in the ORNL 63-in. cyclotron. The compound nucleus resulting from bombardment of S^{32} with 28-Mev nitrogen ions in V^{46} , with an excitation energy of 33.3 Mev. The following nuclear reactions were studied: (1) $\text{S}^{32}(\text{N}^{14}, p)\text{Ti}^{45}$; (2) $\text{S}^{32}(\text{N}^{14}, 2p)\text{Sc}^{44}$; (3) $\text{S}^{32}(\text{N}^{14}, 2p)\text{Sc}^{44m}$; (4) $\text{S}^{32}(\text{N}^{14}, 2pn)\text{SC}^{43}$; (5) $\text{S}^{32}(\text{N}^{14}, 2\alpha)\text{K}^{38}$; and (6) $\text{S}^{32}(\text{N}^{14}, \text{N}^{13})\text{S}^{33}$. The yields as a function of incident energy for these reactions were differentiated to obtain excitation functions. The cross sections for (1), (2) and (3), and (5) are compared with calculations based on the statistical theory of compound nucleus decay. Two values of the level density parameter, a , were employed, first considering and then ignoring de-excitation of a nucleus by gamma-ray emission. The value $a = A/10.5$ fits the p and $2p$ emission cross sections when gamma emission is considered. The excitation function for reaction (6) agrees well with the systematics of previously studied nitrogen-induced transfer reactions. (auth)

10488

INELASTIC SCATTERING OF PROTONS BY VARIOUS NUCLEI. T. Tamura and D. C. Choudhury (Univ. of California, Los Angeles). *Phys. Rev.* **113**, 552-62(1959) Jan. 15.

Experimental data on the inelastic scattering of 23-Mev protons reported by Cohen, Mosko, and Rubin are analyzed by using the theory of direct interaction to-

gether with the plane wave approximation. The most detailed analysis is done for lead isotopes and, at least at 90° , it is found that fairly good agreement with experiment is obtained for the relative magnitudes of the excitation of different excited states. The same idea is also applied to other cases and in particular several arguments are given which will support the view of Lane and Pendlebury for associating the anomalous peaks observed at ≈ 2.5 Mev for nuclei with $Z = 30-53$ with the octupole surface vibrations. Finally discussions are given of the validity of the approximations used in the present analysis and also of the circumstances which still need more refined calculations. (auth)

10489

BETA DECAY OF Be^{11} . D. H. Wilkinson and D. E. Alburger (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **113**, 563-71(1959) Jan. 15.

Be^{11} was obtained in the reaction $\text{B}^{11}(n, p)\text{Be}^{11}$, and its radiations were studied with plastic and NaI(Tl) scintillation spectrometers both singly and in coincidence. The half life as determined from measurements on both beta rays and gamma rays is 13.67 ± 0.15 sec. Decay takes place by beta-ray emission to the ground state of B^{11} (61%, $\log ft = 6.77$, $\beta_{\text{max}} = 11.48$ Mev), to the 2.14-Mev first excited state (29%, $\log ft = 6.63$), to the 6.76-6.81-Mev doublet (6.5%, $\log ft = 5.93$), and to the 7.99-Mev level (4.1%, $\log ft = 5.53$). Limits are set on the decay to several other levels, particularly those at 4.46 and 5.03 Mev ($\leq 0.2\%$). Gamma rays of 2.121, 4.64, 5.86, 6.76, and 7.97 Mev are observed both singly and in coincidence with beta-ray branches. An energy separation $\text{Be}^{11} - \text{B}^{11} = 11.48 \pm 0.15$ Mev is derived from the various beta and gamma-ray energy measurements. It is concluded that the assignment $J = \frac{1}{2}$ for Be^{11} , as expected from the shell model, is possible but cannot be established firmly on the basis of the present evidence. (auth)

10490

DECAY OF THE RADIOISOTOPES Ge^{68} AND Ga^{68} .

Daniel J. Horen (Stanford Univ., Calif.). *Phys. Rev.* **113**, 572-8(1959) Jan. 15.

The decays of Ge^{68} (275 day) and Ga^{68} (68 minute) were reinvestigated with single and coincidence scintillation spectrometers. Comparison of the gamma-ray singles spectra of the two radioisotopes indicates that Ge^{68} decays only to the ground state of Ga^{68} by electron capture. In addition to the known annihilation quanta and a gamma ray of 1.07 Mev in the decay of Ga^{68} , gamma rays of 0.81 ± 0.02 , 1.24 ± 0.02 , and 1.88 ± 0.02 Mev are observed. A level scheme of Zn^{68} with levels at 1.07, 1.88, and 2.31 Mev is proposed and is compared with level schemes of neighboring even-even nuclei. (auth)

10491

INELASTIC PROTON SCATTERING IN MEDIUM-WEIGHT ELEMENTS. Bernard L. Cohen and Allen G. Rubin (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **113**, 579-84(1959) Jan. 15.

Measurements were made of the energy distribution of emitted protons from nuclear reactions induced by protons of various energies between 11 and 23 Mev in elements of atomic number 22 to 30. At intermediate energies, the spectrum shows two maxima; there is strong evidence that the low-energy maximum is due either to "second protons," or to simultaneous emission of two particles. Measurements of nuclear tem-

peratures at 18 Mev are strongly distorted by these effects. At lower bombarding energies, the low-energy contribution may be subtracted off, and distortion of the high-energy part of the spectra by direct ejection is not large, so that the statistical theory of nuclear reactions may be studied. Values obtained for the level density parameter a are independent of the energy of the emitted particle, independent of bombarding energy, slowly varying with atomic weight, and consistent with values obtained from neutron-induced reactions. But when these values are used to calculate cross sections for (n,p) and (p,p') reactions, it is found that protons are emitted with excessive probability in the latter. Some possible explanations for this are discussed. (auth)

10492

BREAKUP OF DEUTERONS BY PROTONS. L. Cranberg and R. K. Smith (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* **113**, 587-9(1959) Jan. 15.

Results are given for the neutron spectra at zero degrees from the reaction $p + d \rightarrow 2p + n$ for a range of incident proton energies from $E_p = 4.0$ to 7.0 Mev. Also given are the spectra as a function of angle for $E_p = 6.5$ Mev. The observed shapes show systematic discrepancies from those given by the theory of Frank and Gammel; these discrepancies increase with increasing proton energy although the reaction yield is accurately given by the theory. (auth)

10493

NITROGEN-INDUCED NUCLEAR REACTIONS IN POTASSIUM. J. J. Pinajian and M. L. Halbert (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **113**, 589-94(1959) Jan. 15.

Excitation functions were measured for the production of Fe^{53} , Fe^{52} , Mn^{52} , Mn^{52m} , Mn^{51} , Cr^{49} , V^{48} , V^{47} , and Ti^{46} from the nitrogen bombardment of potassium in its normal isotopic mixture. The method used was activation of thick targets of KBr followed by chemical separations and absolute beta-counting. The cross sections at 27.5 Mev range from 0.14 mb for Fe^{52} to 8.3 mb for Mn^{51} . The relation of the $Mn^{52}:Cr^{49}:Fe^{52}$ ratio to the odd-even effect in the nuclear level density is discussed. The total cross section for formation of the compound nucleus was estimated at several energies. The fraction of this total accounted for by one-particle emissions from the compound nucleus is surprisingly large. (auth)

10494

INHIBITION OF MAGNETIC DIPOLE RADIATION AND THE IDENTIFICATION OF $T = 1$ STATES IN LIGHT, SELF-CONJUGATE NUCLEI. E. K. Warburton (Princeton Univ., N. J.). *Phys. Rev.* **113**, 595-601 (1959) Jan. 15.

The effects of Coulomb impurities on the inhibition rule of Morpurgo for $\Delta T = 0$, $M1$ transitions in light ($A \leq 20$), self-conjugate nuclei are discussed and a comparison is made between Morpurgo's rule and the experimentally known $M1$ transition strengths. An upper limit to the average inhibition of ~ 10 is indicated by the experimental evidence. There are no known $\Delta T = 0$, $M1$ transitions in light, self-conjugate nuclei with strengths greater than 0.1 Weisskopf unit. The work of Morpurgo is shown to lead to J -dependent lower limits of the order of $0.5 \times 10^{-2} A(A+2)$ Weisskopf units for the matrix elements of $\Delta T = 0$, $M1$ transitions in self-conjugate nuclei. These limits are invoked to assign isotopic spin to several levels in B^{10} , N^{14} , and F^{18} . (auth)

10495

DISINTEGRATION OF IRON-52 AND IRON-53. Jose O. Juliano, C. W. Kocher, T. D. Nainan, and Allan C. G. Mitchell (Indiana Univ., Bloomington). *Phys. Rev.* **113**, 602-8(1959) Jan. 15.

The disintegration of Fe^{52} (8.2 hours) and Fe^{53} (8.9 min) was investigated with the help of scintillation and coincidence counting equipment. Fe^{52} decays 56.5% by positron emission and 43.5% by electron capture. The end-point energy of the positron group is 0.804 ± 0.01 Mev. This is followed by a gamma ray of energy 165 kev leading to Mn^{52m} (21 min). The chain $Fe^{52} \rightarrow Mn^{52} \rightarrow C^{52}$ was studied. In addition to the well-known states of Mn^{52} —the ground state, with character $6+$ and half-life of 5.7 days, and the first excited state (Mn^{52m}), with character $2+$, half-life of 21 min, and energy of 390 kev—these experiments show a third excited state at 555 kev having a configuration $0+$ and a half-life of $(1.2 \pm 0.2) \times 10^{-8}$ sec. The disintegration of Fe^{53} is accompanied by the emission of a gamma ray of energy 380 kev and positron groups of end-point energies 2.84 ± 0.10 , 2.38 ± 0.10 Mev, and an indication of third group at 1.57 ± 0.15 Mev. (auth)

10496

7.65-Mev STATE OF C^{12} . S. F. Eccles and D. Bodansky (Univ. of Washington, Seattle). *Phys. Rev.* **113**, 608-13 (1959) Jan. 15.

The angular distribution for the inelastic scattering of 42-Mev alpha-particles by C^{12} , with excitation of the 7.65-Mev state, was measured. The experimental distribution shows maxima and minima consistent with 0^+ or 2^+ spin-parity assignment for the 7.65-Mev state, on an Austern, Butler, McManus type of direct interaction theory. A search was made for coincidences between the inelastically scattered alpha particles and recoil carbon nuclei in an attempt to determine the probability that the 7.65-Mev state decays by transitions to the ground state of C^{12} . It was found that there is less than one chance in ten that this probability exceeds 0.1%. This low probability is not inconsistent with current theories of helium burning in stars and provides additional support for the usual 0^+ assignment for the 7.65-Mev state. (auth)

10497

DISINTEGRATION OF I^{124} AND I^{123} . Allan C. G. Mitchell, Jose O. Juliano, Charles B. Creager, and C. W. Kocher (Indiana Univ., Bloomington). *Phys. Rev.* **113**, 628-33(1959) Jan. 15.

The disintegration of I^{124} (4.2 days) was studied with the help of magnetic spectrometers and scintillation spectrometers. The disintegration occurs 71% by electron capture and 29% by positron emission. Three positron groups were found having end-point energies of 2130 (46.0%), 1531 (46.4%), and 786 (7.5%) kev. The most energetic positron group has a shape characteristic of $\Delta I = \pm 2$, yes. Positron-gamma coincidence experiments show that this group goes to the ground state. Gamma rays of energies 2700, 2300, 2100, 1700, 1520, 1350, 723, and 603 kev together with annihilation radiation and Te K x-rays were found and the relative intensities measured. A disintegration scheme, consistent with the levels of Te^{124} as determined from the decay of Sb^{124} , was established. No beta rays were found, showing that a transition to Xe^{124} is highly improbable. The former work on I^{123} (13.5 hours) was substantiated and, in addition, it seems highly unlikely that any positrons are emitted from I^{123} . (auth)

10498

SCINTILLATION STUDIES OF SOME NEUTRON DEFICIENT ISOTOPES OF LUTETIUM. L. T. Dillman, R. W. Henry, N. B. Gove, and R. A. Becker (Univ. of Illinois, Urbana). *Phys. Rev.* **113**, 635-40(1959) Jan. 15.

Lu^{170} , Lu^{172} , Lu^{173} , and Lu^{174} activities were produced by bombarding Lu_2O_3 with bremsstrahlung from the University of Illinois betatrons. Gamma rays of energy 0.083, 0.190, 0.245, and 2.04-Mev were associated with the decay of Lu^{170} . A gamma-gamma coincidence experiment showed that the 2.04-Mev gamma ray was coincident with the three low-energy transitions. Gamma rays of energy 0.079, 0.113, 0.181, 0.203, 0.325, 0.370, 0.525, 0.820, 0.900, and 1.09 Mev were associated with the electron capture decay of 6.7-day Lu^{172} , the isotope studied in the most detail. Levels of energy 0.0787, 0.2602, 0.3731, 0.5769, 0.9015, 1.082, and 1.99 Mev above the ground state have been assigned to Yb^{172} by gamma-gamma coincidence measurements and energy considerations. Gamma rays of energy 0.022, 0.079, 0.113, 0.145, 0.176, 0.274, 0.335, 0.440, 0.550, and 0.640 Mev were assigned to transitions between levels of Yb^{173} while gamma rays of energy 0.077, 0.084, 0.113, 0.176, 0.230, 0.275, 0.990, and 1.245 Mev were associated with the decay of Lu^{174} . A summary of all gamma-gamma coincidence experiments involving Lu^{173} and Lu^{174} is included in this paper. The 0.084-Mev transition associated with the decay of Lu^{174} was interpreted to be the first excited level of Hf^{174} . A rough calculation of the K-conversion coefficient of this transition yielded $\alpha_K \leq 2.5$. (auth)

10499

HIGH-SENSITIVITY MASS SPECTROMETRIC MEASUREMENT OF STABLE HELIUM AND ARGON ISOTOPES PRODUCED BY HIGH-ENERGY PROTONS IN IRON. Oliver A. Schaeffer and Josef Zahringer (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **113**, 674-8(1959) Jan. 15.

A high-sensitivity mass spectrometer was used to measure the helium, argon, and neon produced in iron by 0.16-, 0.43-, and 3.0-Bev protons. The spectrometer has a sensitivity so that 10^{-11} standard cc of helium could be detected above the contamination level. The He^4 cross sections are 120 mb, 450 mb, and 1300 mb at 0.16, 0.43, and 3.0 Bev, respectively, while the He^3/He^4 cross section ratios are, respectively, 0.09, 0.10, and 0.18. At 0.43 Bev, cross sections of 1.0 mb, 3.3 mb, 8 mb, and 4.1 mb were found for the argon isotopes 36, 37, 38, and 39, respectively. The cross section for neon-21 is 0.1 mb at 0.43 Bev. The results are discussed in relation to evaporation theory and the rare gas content of iron meteorites. The He^3 yields are all higher than previously measured tritium values. At 3 Bev the He^3/T ratio is 2.4. It is suggested that in the case of iron in evaporation theory the Coulomb barrier is not as important relatively as previously thought. Alternatively, a large fraction of the He^3 and tritium may be produced during the nuclear cascade which precedes the evaporation from the excited nuclei. The cross sections measured bear directly on the cosmic-ray-produced rare gases in meteorites. From the cross section of directly produced He^3 relative to T, previous measurements of He^3 -T exposure ages of iron meteorites must be reduced by a factor of about 3. From the argon isotope cross sections it is seen that 80% of the Ar^{36} in meteorites is the result of β decay of cosmic-ray-produced Cl^{36} and thus Ar^{36} - Cl^{36} should

be a reliable method for measuring exposure ages of meteorites. (auth)

10500

CAPTURE OF NEGATIVE MUONS BY NUCLEI. J. C. Sens (Univ. of Chicago). *Phys. Rev.* **113**, 679-87(1959) Jan. 15.

An experiment conducted to obtain precise values for the rates at which negative muons are captured by nuclei is described. These capture rates were deduced from muon disappearance rates measured by determining the time distribution of electrons resulting from the decay of muons in their lowest atomic orbit. 30 elements were investigated, using scintillation counters as detectors. The data are compared with the general theory of Primakoff and the specific predictions of Tolhoek and Luyten for nuclei with $20 \leq Z \leq 28$. Primakoff's predictions for the effect of the Pauli principle are well born out by this experiment, and the inferred capture rate of muons by protons is in good agreement with the hypothesis of a universal Fermi interaction. New values of effective nuclear charge densities (analogous to Wheeler's Z_{eff}^4) were computed for analyzing the data, using a recent muon mass and up-to-date experimental information on charge distributions. These new values are presented in tabular form. (auth)

10501

ELASTIC SCATTERING OF 150-Mev NEGATIVE PIONS BY NUCLEI. Tadao A. Fujii (Univ. of Chicago). *Phys. Rev.* **113**, 695-709(1959) Jan. 15.

The elastic scattering of 150-Mev negative pions by complex nuclei was experimentally studied by the use of energy-sensitive Čerenkov detectors with a pulse-height analyzer. The elastic scattering could be distinguished from inelastic processes within the 10^{-1} -Mev resolution width of these detectors. The differential cross sections of carbon, aluminum, copper, and lead were measured at angles between 18.5° and 43.6° . In addition, measurements on carbon and lead were extended to large angles between 45° and 139° . It was found that elastic scattering was confined predominantly to the forward angles less than 60° . Calculations based on the optical model with a square well were carried out to obtain the values of parameters which provided the best fit to the data. They are $-30 \text{ Mev} \geq V_R \geq -40 \text{ Mev}$, $-65 \text{ Mev} \geq V_I \geq -75 \text{ Mev}$, and $1.3 \times 10^{-13} \text{ A}^{1/2} \text{ cm} \leq R \leq 1.4 \times 10^{-13} \text{ A}^{1/2} \text{ cm}$, where V_R and V_I are real and imaginary parts of the potential, R is the nuclear radius, and A is the nuclear mass. The corresponding values of the reaction mean free path were of the order of the pion Compton wavelength. These values are close to those predicted by Frank, Gammel, and Watson from the knowledge of the pion-nucleon interaction. (auth)

10502

GAMMA RAYS OF PROMETHIUM-152. A. H. W. Aten, Jr. and Gerda Wolzak (Instituut voor kernfysisch Onderzoek, Amsterdam). *Physica* **25**, 50(1959) Jan.

Evidence is presented in support of identification of a 7-min. period observed in fast neutron irradiation of Sm^{152} to Pm^{152} formed by an (n,p) reaction. (T.R.H.)

10503

GAMMA RADIATION FOLLOWING THE DECAY OF ^{124}Sb AND ^{124}I . R. K. Girgis and R. van Lieshout (Instituut voor kernfysisch Onderzoek, Amsterdam). *Physica* **25**, 133-48(1959) Feb.

The gamma radiation following the decay of 60-day Sb^{124} and 4.1-day I^{124} has been investigated with a scintillation spectrometer. A new gamma ray of 1900 keV has been found in the decay of Sb^{124} . Gamma rays of 605, 644, 725, 890, 970, 1055, 1320, 1370, 1450, 1510, 1695, 1900, 2090, 2260, and 2745 keV have been found in the decay of I^{124} . Relative intensities of the gamma rays are reported, and a tentative level scheme for Te^{124} is proposed. (auth)

10504

LIFETIME OF THE 241 keV STATE OF ^{220}Th . J. G. Siekman and G. T. Pott (Rijks-Universiteit, Groningen, Netherlands). *Physica* 25, 179-81 (1959) Feb.

The lifetime of the 241-keV excited state was measured by delayed fast coincidence using the alphas feeding the level and the 142.2-keV K-conversion electrons de-exciting it. A value of $4.5 \pm 1.6 \times 10^{-10}$ sec is reported. (T.R.H.)

10505

THE EXCITATION MECHANISM OF Ar^+ IONS OF 5-24 keV IN He, Ne, Ar, Kr, Xe. Th. J. M. Sluyters and J. Kistemaker (Laboratorium voor Massaspectrografie, Amsterdam). *Physica* 25, 182-4 (1959) Feb.

A special grating vacuum monochromator is described which detects very weak light intensity. This instrument was used to measure the excitation in the range 5 to 24 keV with Ar^+ ions in He, Ar, Kr, Ne, and Xe. The following mechanism is offered: direct excitation of the primary ion beam and target atoms or indirect excitation by charge-exchange. (T.R.H.)

10506

THE HISTORY OF DOUBLE SCATTERING OF ELECTRONS AND EVIDENCE FOR THE POLARIZATION OF BETA RAYS. L. Grodzins (Brookhaven National Lab., Upton, N. Y.). *Proc. Natl. Acad. Sci. U.S.A.* 45, 399-405 (1959) Mar.

It is pointed out that in 1928 Cox, McIlwraith, and Kurrelmeyer (*Proc. Natl. Acad. Sci. U.S.A.* 14, 544) performed experiments in double scattering of Ra beta rays which evidence negative helicity for beta rays and, therefore, parity violation in weak interactions. Further experimentation is reviewed and discussed. (T.R.H.)

10507

AN INVESTIGATION OF THE ENERGY LEVELS OF ^{26}Al . S. Hinds and R. Middleton (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). *Proc. Phys. Soc. (London)* 73, 501-7 (1959) Mar.

The energy levels of Al^{26} were investigated by magnetic analysis using the reactions $\text{Al}^{27}(\text{He}^3, \alpha)\text{Al}^{26}$ and $\text{Mg}^{24}(\text{He}^3, p)\text{Al}^{26}$ at an incident energy of 5.8 MeV. The positions of 70 excited states of Al^{26} are reported below an excitation energy of 6.865 MeV. No evidence was found for a doublet at 2.08 MeV. (auth)

10508

THE $^{24}\text{Mg}(\text{He}^3, \alpha)^{23}\text{Mg}$ REACTION. F. de S. Barros, P. D. Forsyth, A. A. Jaffe, and I. J. Taylor (Univ. of Manchester, Eng.). *Proc. Phys. Soc. (London)* 73, 513-15 (1959) Mar.

The reaction $\text{Mg}^{24}(\text{He}^3, \alpha)\text{Mg}^{23}$ was investigated at a bombarding energy of 5.23 MeV, and the reaction products were analyzed by means of a 90° broad-range magnetic spectrograph. A target of natural magnesium evaporated on a plastic foil, previously coated with a thin layer of gold to ensure even deposition of the magnesium, was placed at an angle of 45° to the beam with backing facing the beam. Exposures up to 4500

micro-coulombs were made at angles of 10°, 40°, and 90° with respect to the He^3 beam. The spectrum is graphically shown. A comparison of the observed levels of Mg^{23} with the known levels of its mirror, Na^{23} , is shown. The correspondence between the excitations of successive levels in the two nuclei is good and is particularly striking in the case of the first excited state. (A.C.)

10509

THE ELASTIC SCATTERING OF FAST ELECTRONS AND POSITRONS BY HYDROGEN AND HELIUM ATOMS. B. L. Moiseiwitsch and A. Williams (Queen's Univ., Belfast). *Proc. Roy. Soc. (London)* A250, 337-45 (1959) Mar. 24.

A simplification of the second Born approximation due to Massey & Mohr is used to calculate the differential cross-sections for the elastic scattering of fast electrons and fast positrons by hydrogen atoms and helium atoms, the method of Dalitz being applied to evaluate all the relevant integrals. Although the logarithmic singularity which is found in the differential cross-section for zero-angle scattering is shown to be absent in the true second Born approximation the use of the simplification of this approximation is justified at sufficiently high impact energies provided the angle of scattering is not too small. The results of the calculations for incident electrons in helium are compared with the available experimental data. (auth)

10510

YIELD OF THE NUCLEAR REACTION $\text{Al}^{27}(\text{d}, 2\text{p})\text{Mg}^{27}$. R. Radicella, J. Rodriguez, G. B. Baro, and O. Hittmair. *Publ. com. nacl. energía atómica (Buenos Aires) Ser. quim.* 1, No. 13, 189-94 (1958). (In Spanish)

The total cross section of the reaction $\text{Al}^{27}(\text{d}, 2\text{p})\text{Mg}^{27}$ was determined by comparing the activity of the Mg^{27} obtained with the saturation of the Na^{24} produced simultaneously in the reaction $\text{Al}^{27}(\text{d}, \text{p}\alpha)\text{Na}^{24}$. The cross section of the latter reaction is known. The maximum energy of the deuterons used was 28 MeV. A description was given of the irradiation and measurement techniques, and the results obtained are discussed with respect to the method of producing the reaction. (tr-auth)

10511

A NEW ISOTOPE OF HAFNIUM Hf^{183} . O. O. Gatti and J. Flegenheimer. *Publ. com. nacl. energía atómica (Buenos Aires) Ser. quim.* 1, No. 14, 195-203 (1958). (In Spanish)

Fast neutron bombardments on W show a 64 ± 3 min half life in the hafnium fraction. The maximum β^- energy of this nuclide is about 1.4 MeV and its total disintegration energy Q_{β^-} is about 2.2 MeV. This value agrees with the predicted Q_{β^-} value for Hf^{183} . The mass number is confirmed by the amount of the radioactive Ta^{183} formed after decay of the hafnium. The reported 10-minute half life for Ta^{183} is confirmed. (auth)

10512

A MODEL OF NUCLEAR POTENTIAL. Susana P. Levy de Bollini. *Publ. com. nacl. energía atómica (Buenos Aires) Ser. fis.* 1, No. 16, 275-324 (1958). (In Spanish)

By the use of a model of central potential for the nucleus, defined by two parameters which are established so as to give a description of a level inversion (originating in the second nuclear layer when a square well potential is used), the calculation of the total cross sections of nuclei with radii between 4.5 and 7×10^{-13} cm, before bombardment with neutrons of energies between 1 eV and 10 MeV, is attempted. With this object,

the optical model of the nucleus is used, adding to the central potential an imaginary part proportional to the potential, and giving a calculation of the absorption of the incident neutron wave. The results found are compared with experimental results and with those obtained by Feshbach, Porter, and Weisskopf (*Phys. Rev.* **96**, 448(1954)) who used the square well potential. The agreement obtained is satisfactory if smaller values of nuclear radius than those used by previous investigators are accepted. (tr-auth)

10513

ENERGY LEVELS OF Sc^{45} AND Ca^{42} . W. W. Buechner and M. Mazari (Massachusetts Inst. of Tech., Cambridge). *Rev. mex. fis.* **7**, 117-28(1958).

The spectra of the $\text{Sc}^{45}(\text{p}, \text{p}')$ and $\text{Sc}^{45}(\text{p}, \alpha)\text{Ca}^{42}$ reactions were studied with a high-resolution magnetic spectrograph with angles of 50, 90, and 130° to the direction of the beam. The proton beam had an energy of 6.52 Mev. The excited states of Sc^{45} and Ca^{42} are tabulated. A value of $Q = 2.341 \pm 0.008$ was determined for the $\text{Sc}^{45}(\text{p}, \alpha)$ reaction. (J.S.R.)

10514

DIRECTIONAL CORRELATION INVESTIGATIONS ON THE γ RADIATION OF Cd^{110} . U. Cappeller and E. Ganssauge (Univ. of Marburg a. d. Lahn, Ger.). *Z. Physik* **153**, 592-608(1959). (In German)

For the determination of the angular momentum quantum number of the excited state of the Cd^{110} nucleus, the directional correlation between the γ radiation occurring in the decay of $\text{Ag}^{110\text{m}}$ was measured with two scintillation spectrometers connected in coincidence. For an evaluation of the measurements the coincidence rates measured at different calibrations of the spectrometer must be resolved into the constituents correlating the single cascades. A method was indicated. From the results of the measurements, the angular momentum quantum numbers of the levels of the Cd^{110} nucleus at energies of 1539, 2484, and 2920 keV could be given. (tr-auth)

10515

THEORY OF THE PHOTOFISSION OF DEUTERONS AT AVERAGE ENERGIES. Biswarup Banerjee, Gustav Kramer, and Lorenz Krüger (Univ. of Heidelberg, Ger.). *Z. Physik* **153**, 630-42(1959). (In German)

The differential cross section for the photodisintegration of the deuteron is calculated on the basis of a phenomenological theory for energies up to 80 MeV, assuming the validity of Siegert's theorem. The Hulthén wave function with a 4% D-state admixture for the ground state is used. The final state potential is approximated by a square-well of a given radius, the depth of which is calculated from the phase-shifts given by Marshak. For both the ground state and the final states a hard-core of radius 0.4×10^{-13} cm is introduced. Only the electric and magnetic dipole transitions are considered. For the isotropic term a fairly constant value is obtained which agrees with the experimentally observed energy-dependence but is about 20% smaller than the experimental value. The coefficient of the $\sin^2\theta$ term agrees well with the experimental results. (auth)

10516

THE FIRST PARTIAL SPECTRUM OF THE Co^{60} β DECAY. Friedrich Bonhoeffer (Univ. of Göttingen, Ger.). *Z. Physik* **154**, 62-9(1959). (In German)

The first partial spectrum of the Co^{60} β decay was

measured with a scintillation spectrometer. The maximum energy was found at $E_{\text{max}} = 318 \pm 7$ keV. The pattern of the spectrum agreed with the β decay theory from 10 keV up to E_{max} . The Co preparation was placed in an anthracene split crystal (I), which was surrounded by a large NaI crystal (II). The impulse from I was then recorded only when the gamma quanta resulting from the electrons in cascade were detected simultaneously and in coincidence with the pulses of the summation lines of the γ spectrum. The method is suitable for the measurement of the first partial spectrum of complex β decays in weak activities when it is difficult in usual spectroscopy because of the electrons of other partial spectra and gamma radiation. (tr-auth)

10517

NUCLEAR SPECTROSCOPY INVESTIGATIONS ON $\text{Ag}-\text{Cd}^{110}$ AND $\text{Sb}-\text{Te}^{124}$. Edmund Boschitz (Univ. of Erlangen, Ger.). *Z. Physik* **154**, 90-110(1959). (In German)

The energy schemes of the nuclei $\text{Ag}-\text{Cd}^{110}$ and $\text{Sb}-\text{Te}^{124}$ were checked by means of coincidence spectra traced with a 100-channel pulse analyzer and a slow-fast coincidence circuit ($2\tau = 25 \times 10^{-8}$ sec). With similar apparatus (the use of a second single-channel analyzer in place of the 100-channel analyzer) the angular correlation of three cascades was measured, and a spin 2 was assigned to the 1.52-MeV level in Cd^{110} and spin 3 to the 2.28- and 2.70-MeV levels in Te^{124} . (tr-auth)

10518

INTERMEDIATE ENERGY PHOTO-DEUTERONS FROM C^{12} AND Be^9 . V. P. Chizhov and L. A. Kulchitskii (Leningrad Inst. of Physics and Tech.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 345-52(1959) Feb. (In Russian)

The energy distribution of deuterons and protons and the energy dependences of the ratios of the deuteron to proton yields are presented for the case of photodisintegration of C^{12} and Be^9 . In the case of C^{12} the disintegration was induced by the bremsstrahlung of $E_{\text{ymax}} = 80$ MeV from a synchrotron and $E_{\text{ymax}} = 90$ MeV in the case of Be^9 . A semiempirical analysis of the results pertaining to deuterons is carried out under the assumption that the deuterons are formed in the so-called pick-up process. The analysis is also extended to the experimental results of other investigators. (auth)

10519

DETERMINATION OF THE LIFETIME OF THE FIRST EXCITED STATE OF THE Be^{10} NUCLEUS. A. N. Boyarkina and A. F. Tulinov (Inst. of Nuclear Physics, Moscow State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 353-61(1959) Feb. (In Russian)

A theory of the method for determining the lifetime of the excited states of atomic nuclei based on the application of recoil nuclei is presented. An experiment is described in which the lifetime, τ , of the Be^{10} nucleus in the 3.37-MeV excited state was measured. An upper limit for τ was obtained, $\tau < 8 \times 10^{-14}$ sec. (auth)

10520

SPECTRUM OF THE INTERNAL CONVERSION ELECTRONS ACCOMPANYING THE α -DECAY OF Pu^{238} AND Pu^{240} . E. F. Tretyakov, L. N. Kondratev, G. I. Khlebnikov, and L. L. Goldin. *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 362-6(1959) Feb. (In Russian)

The spectrum of conversion electrons accompanying α decay of Pu^{238} and Pu^{240} was studied with a large-aperture magnetic spectrometer with toroidal field shape, measuring α -e coincidences. Transitions from

the 6+ excited levels were detected. The multipolarity and more precise energy values were determined for transitions from the 4+ and 2+ levels. (tr-auth)

10521

CASCADE α -PARTICLES FROM DISINTEGRATIONS INDUCED BY 360 AND 660 Mev PROTONS. V. I. Ostroumov, N. A. Perfilov, and R. A. Filov (Radium Inst., Academy of Sciences, U.S.S.R.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 367-75(1959) Feb. (In Russian)

Stars containing tracks of α particles with energies above 30 Mev were studied in a nuclear emulsion irradiated by 360- and 660-Mev protons. The effective cross section for production of these stars, the angular distribution of the fast α particles, and their relative probability for emission from light and heavy emulsion nuclei were determined. Emission of cascade α particles and emission from nuclei of fragments as a result of bombardment with protons of the same energies were found to be quite similar. This seems to indicate that the α particles are produced by an identical type of mechanism. (auth)

10522

RELATIVISTIC CORRECTIONS TO THE PHENOMENOLOGICAL THEORY OF LIGHT NUCLEI LEVELS. F. A. Zhivopistsev, A. M. Perelomov, and Yu. M. Shirokov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 478-80(1959) Feb. (In Russian)

Relativistic corrections to the (phenomenologically prescribed) interaction between a pair of nucleons in a nucleus is computed on the basis of the expression obtained for relativistic corrections to the nonrelativistic two-body Hamiltonian. It is found that the relativistic corrections strongly depend on the shape of the potential and are of the order of 0.02 to 0.2 Mev for a pair of nucleons. (auth)

10523

ON THE THEORY OF NUCLEAR PARAMAGNETIC RESONANCE IN LIQUIDS. G. V. Skrotskii and A. A. Kokin. Zhur. Eksptl'. i Teoret. Fiz. **36**, 481-7(1959) Feb. (In Russian)

The quantum theory of magnetic resonance absorption is applied to describe nuclear paramagnetic resonance in liquids. Thermal motion of the molecules which leads to narrowing of the absorption line is taken into account on the basis of diffusion theory. The transverse and longitudinal relaxation times and the correction to the gyromagnetic ratio are computed. (auth)

10524

ON THE SHAPE OF α -ACTIVE NUCLEI. L. L. Goldin, G. I. Novikova, and K. A. Ter-Martirosyan. Zhur. Eksptl'. i Teoret. Fiz. **36**, 512-16(1959) Feb. (In Russian)

The rate of α decay to the successive levels of the main rotational band of the daughter nucleus permits one to determine the shape of heavy nuclei. The quantities α_2 and α_4 which are the coefficients in the expansion of the nuclear shape in terms of Legendre polynomials are computed. The calculations are performed for four even and three odd nuclei. The results of the calculations satisfactorily agree with each other and indicate that the contribution of the term $\alpha_4 P_4(\cos \theta)$ to the nuclear shape is significant. (auth)

10525

POLARIZATION OF β -ELECTRONS FROM RaE. B. V. Geshkenbein, S. A. Nemirovskaya, and A. P. Rudik.

Zhur. Eksptl'. i Teoret. Fiz. **36**, 517-25(1959) Feb. (In Russian)

Effects due to nonconservation of parity in the β decay of RaE are considered. A formula is derived for longitudinal polarization of β electrons. The magnitude of the longitudinal polarization is found not to equal v/c . The complete calculation is performed with account of the possibility that time parity may not be conserved. The experimental data relating to the magnitude of the polarization of the RaE β electrons significantly restrict the region of possible violation of time parity. (auth)

10526

POLARIZATION OF β -PARTICLES AND β - γ -CORRELATION FOR FIRST FORBIDDEN TRANSITIONS IN ORIENTED NUCLEI. A. Z. Dolginov and N. P. Popov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 529-38(1959) Feb. (In Russian)

Explicit formulas were obtained for the polarization of β particles and β - γ correlation for first-forbidden transitions in oriented nuclei. All five types of β coupling are considered with account of parity nonconservation. The Coulomb field of an extended nucleus is considered. Nonoriented nuclei are examined as a particular case. (auth)

10527

INVESTIGATION OF THE AVERAGE NUCLEAR POTENTIAL PARAMETERS. L. A. Sliv and B. A. Volchok (Leningrad Inst. of Physics and Tech., Academy of Sciences, U.S.S.R.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 539-53(1959) Feb. (In Russian)

The parameters of the average nuclear potential were found on the basis of data pertaining to the levels of nuclei with a number of nucleons equal to that of a doubly closed shell plus or minus one nucleon. Results of the calculations are presented. It is shown that the potential parameters are the same for all nuclei lying on the nuclear stability curve. A formula was derived for the depth of the potential for prescribed values of N and Z. Expansion of the nucleon functions in terms of spherical oscillator functions is considered. (auth)

10528

SCATTERING OF NEUTRONS BY ORIENTED NON-SPHERICAL NUCLEI. G. L. Visotskii, E. V. Inopin, and A. A. Kresnin (Inst. of Physics and Tech., Academy of Sciences, Ukrainian S.S.R.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 574-80(1959) Feb. (In Russian)

Scattering of neutrons by oriented nonspherical nuclei is examined. The opaque nuclear model is employed in the calculations of the scattering cross section. It is demonstrated that nonsphericity effects are more appreciable in oriented nuclei than in nonoriented nuclei. It is also shown that a noticeable azimuthal asymmetry appears in the angular distribution of neutrons scattered on oriented nonspherical nuclei. (auth)

10529

ON WEAK INTERACTIONS POSSIBLE IN THE FEYNMAN-GELL-MANN SCHEME. V. M. Shekhter (Leningrad Inst. of Physics and Tech., Academy of Sciences, U.S.S.R.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 581-4(1959) Feb. (In Russian)

It is shown that the β -decay current is uniquely defined by the requirement that the divergence of its vector part vanishes. Moreover, the current responsible for hyperon decay should not be conserved. If this were not the case the strong interaction Lagrangian would possess a symmetry which would contradict the experi-

ments on simultaneous creation of strange particles. As a result, the reaction $\Sigma \rightarrow \Lambda + e + \nu$ can occur only by virtue of Λ coupling. (auth)

10530

CORRELATION BETWEEN THE DIRECTION OF AN INTERNAL BREMSSTRAHLUNG QUANTUM AND CIRCULAR POLARIZATION OF A γ -QUANTUM EMITTED BY AN EXCITED NUCLEUS AFTER K-CAPTURE.

G. M. Handelman. *Zhur. Eksptl'. i Teoret. Fiz.* 36, 585-7(1959) Feb. (In Russian)

The correlation between the γ quantum from radiative K capture and the circularly polarized γ quantum from an excited nucleus is studied. A general formula was deduced for the correlation and its dependence on the spins of the initial, excited, and final states of the nuclei. (auth)

10531

CALCULATION OF POLARIZATION OF 0.1-1 Mev NEUTRONS. P. E. Nemirovskii. *Zhur. Eksptl'. i Teoret. Fiz.* 36, 588-93(1959) Feb. (In Russian)

The polarization of 0.1 to 1 Mev neutrons scattered on heavy nuclei is investigated. It is shown that the polarization can be described with satisfactory accuracy by introducing in the optical potential an additional term of the form $-[(x/r)(dV/dr)(\sigma)]$, where $x = 3 \times 10^{-27}$ cm². The best agreement between theory and experiment is obtained when the imaginary part of the potential is 2.5 Mev. (tr-auth)

10532

ON COLLECTIVE EFFECTS IN LIGHT NUCLEI. V. V. Balashev and A. F. Tulipov (Moscow State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* 36, 615-16(1959) Feb. (In Russian)

The light nucleus shell theory is in good agreement with experimental data on magnetic moments and probabilities of magnetic dipole γ transitions. However, such agreement is not found in tabulated data of E-2 transitions and electric quadrupole probabilities for C¹², B¹⁰, and Be⁹. The measured quadrupole moments of the nuclei are considerably higher than those calculated according to the shell theory. An assumption exists that this condition is related to nucleon collective motion in nuclei. Hence, a generalized analysis was made of the relative collective effects in nuclei not related to the mechanism of collective intensifications of electric quadrupole transitions. The data obtained confirm the assumption that increased quadrupole transition probabilities are related to collective effects and that these effects are actually absent in transitions with changes in isotopic spin. (R.V.J.)

10533

ON THE FORMATION OF COMPLEX NUCLEI IN INTERACTIONS OF ATOMIC NUCLEI. A. S. Karamyan, Yu. B. Gerlit, and B. F. Myasoedov. *Zhur. Eksptl'. i Teoret. Fiz.* 36, 621-3(1959) Feb. (In Russian)

Interactions of multicharged ions with nuclei of various elements and the processes of complete nuclear fusion followed by neutron evaporation were studied. The cross section dependence of reactions with the emission of a given number of neutrons on the excitation of the compound nucleus was used as a criterion of the reaction. The cross section dependence of the reaction $Au(n, 4 \text{ to } 6n)$ on the excitation energy of the compound nucleus Em^{211} and of the $V(N, xn)$ reaction on the excitation energy of the compound nucleus Zn^{66} was found. A comparison was made of the energy dependence

of evaporation reaction cross sections on the multicharged ions and protons close to the compound nuclei. Graphs of the data for $V(N^{14}, p^3n + 4n)$, $V(N^{16}, 5n)$, $V(C^{12}, 2n)$, $V^{61}(C^{13}, 3n)$, $Cu^{65}(p, p^3n + 4n)$, $Cu^{65}(p, 3n)$, and $Cu^{63}(p, 2n)$ are compared with published data. It is confirmed that for nuclear target mass number from 50 to 200 interactions with multicharged ions are in most cases followed by the production of compound nuclei. (R.V.J.)

10534

ON THE EMISSION MECHANISM OF PROMPT FISSION NEUTRONS. V. S. Stavinskii. *Zhur. Eksptl'. i Teoret. Fiz.* 36, 629-30(1959) Feb. (In Russian)

Some inconsistencies are pointed out in recently reported measurements made on the spectral distributions of fission neutrons. Calculations related to the fragment distribution contradict the accepted concept of the prompt neutron emission mechanism. (R.V.J.)

10535

THE Te^{125m} PRODUCTION CROSS SECTION IN (n, γ) REACTION. V. S. Gvozdev and Yu. L. Khazov (Leningrad Inst. of Physics and Tech.). *Zhur. Eksptl'. i Teoret. Fiz.* 36, 632-3(1959) Feb. (In Russian)

The production cross section for Te^{125} (spin 11/2) isomeric state in (n, γ) reactions was measured. The cross section was determined by comparison to the $Hf^{180}(n, \gamma)Hf^{181}$ cross section, considered to be 10 ± 3 b. The Te^{125m} and Ta^{181} internal conversion electron spectra produced by Te^{125m} and Hf^{181} β decay were studied with a β spectrometer. The Te^{125m} production cross section was (40 ± 25) mb and the production cross section ratio of Te^{125m} (spin 11/2) and Te^{125} (spin 1/2) was 0.006. (R.V.J.)

10536

REACTION $T(p, n)He^3$ FOR 7 TO 12 MEV PROTONS. G. F. Bogdanov, N. A. Vlasov, et al. *Zhur. Eksptl'. i Teoret. Fiz.* 36, 633-6(1959) Feb. (In Russian)

Measurements were made of the angular distribution and cross sections for the $T(p, n)He^3$ reaction at proton energies of 7 to 12 Mev. An attempt was also made to measure the polarization of neutrons in the reaction. (R.V.J.)

10537

POLARIZATION OF Au^{198} NUCLEI IN GOLD-IRON SOLUTION. B. N. Samoilov, V. V. Sklyarevskii, and E. P. Stepanov. *Zhur. Eksptl'. i Teoret. Fiz.* 36, 644 (1959) Feb. (In Russian)

Results are given of experiments carried out on the polarization of Au^{198} nuclei in gold-iron irradiated by thermal neutrons. The γ rays were recorded with two scintillation counters with CsI crystals. The Au^{198} β decay (transition $2^- \rightarrow 2^+$) is followed by γ emission at 411 keV (transition $2^+ \rightarrow 0^+$). The magnitude $\beta = \mu H/kT$ (μ is the Au^{198} magnetic moment, I is the spin, and H is the magnetic field of the Au^{198} nucleus) is within the limits of 0.3 to 0.4 and the nuclear polarization of Au^{198} is within 0.25 to 0.35. The magnitude of H is found to be $(0.5 \text{ to } 0.7) \times 10^6$ gauss. (R.V.J.)

10538

LEHRBUCH DER THEORETISCHEN PHYSIK. SWEITER BAND. STRUKTUR DER MATERIE. (Textbook of Theoretical Physics. Vol. II. Structure of Matter.) Walter Weizel. Berlin, Springer-Verlag, 1958. p.805-1793.

In the second volume of a textbook on theoretical physics, the structure of matter is considered.

Elementary atomic theory, quantum theory, field theory of matter, nuclear physics, molecules and chemical bonding, statistics, structure and properties of gases, electronics, and structure and properties of cohesive matter are considered. The sections on field theory of matter and electronics are new discussions added to the second edition. (J.S.R.)

10539

PREVRASHCHENIYA ATOMNYKH YADER. (Transformations of Atomic Nuclei). Vitalii Iosifovich Goldanskii and Evgenii Moiseevich Leykin. Moscow, Izd-vo AN SSSR, 1958.

A book intended for people with a knowledge of physics and who wish to increase their knowledge of the basic problems of nuclear physics is presented. The properties of atomic nuclei and elementary particles, models of atomic nuclei, methods and means of carrying out and observing nuclear reactions, detailed descriptions of methods of using nuclear reactions to obtain information on the structure of nuclei, and descriptions of the reactions used to obtain fission chain reactions and thermonuclear reactions are considered. (TCO-J.S.R.)

Theory

10540 AFOSR-TN-58-816a
AFOSR-TN-58-816b
AFOSR-TN-58-816c

Maryland. Univ., College Park.

LECTURES ON DISPERSION RELATIONS IN QUANTUM FIELD THEORY AND RELATED TOPICS. Technical Report No. 115. John G. Taylor. [1958]. (Vol. 1, 92p.; Vol. 2, 91p.; and Vol. 3, 86p.). Contract AF49(638)-24.

These reports (further identified as AD-202639; AD-202640; and AD-202641, respectively) were issued separately, but are cataloged as a unit.

Notes on a series of lectures on dispersion relations in quantum field theory and related topics, given at the University of Maryland during the summer of 1958 by Visiting Associate Research Professor John G. Taylor, are presented. The seminar consisted of twelve lectures. A selected bibliography is given. (W.D.M.)

10541 ANL-5982

Argonne National Lab., Lemont, Ill.

SUMMER LECTURES ON THEORETICAL PHYSICS, 1958. R. Haag, S. N. Gupta, M. Dresden, P. Havas, and F. Coester. Mar. 1959. 253p. Contract W-31-109-eng-38. \$4.00(OTS).

Some lectures on theoretical physics are presented, mostly in the field of elementary particles and field theory, delivered during the summer of 1958 by visitors at the Argonne National Laboratory. The lectures are essentially summaries or reviews of published material. Lectures included are on collision theory for composite particles, quantum theory of fields, inquiries into field theory, classical relativistic theory of elementary particles, and bound states of many-particle systems. (W.D.M.)

10542 CERN-59-7

European Organization for Nuclear Research, Geneva. NOTES ON QUATERNION QUANTUM MECHANICS. PART I. David Finkelstein, J. M. Jauch, and David Speiser. Feb. 1959. 18p.

A kind of quantum mechanics is developed in which the coefficients or c-numbers do not commute with each

other. The necessary results of quantum mechanical logic are laid out, and the operator formalism is set up. The group representation problem and the relation to ordinary quantum mechanics are discussed. (W.D.M.)

10543 CRT-813

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

REPRESENTATIONS OF THE INHOMOGENEOUS LORENTZ GROUP. T. D. Newton. Dec. 1958. 95p. (AECL-731). \$2.00(AECL).

Prepared as a chapter for Vol. I of "Theorie Des Groupes et ses Applications en Physique et Chimie Moderne" by T. Kahan and others.

10544 NP-7344

Joint Inst. for Nuclear Research, Dubna, U.S.S.R.

Lab. of Theoretical Physics.

CALCULATION OF THE STATISTICAL WEIGHTS BY MONTE-CARLO METHOD. Yu. (Ju.) N. Blagoveschenskii (Blagoveschensky) and G. I. Kopylov. 1958. 15p.

A new way of calculation of repeated integrals of any multiplicity by Monte Carlo method is proposed. Its application to the calculation of the statistical weights under multiple production processes and the possibilities of its application in different cases are discussed. (J.E.D.)

10545 NP-7349

Joint Inst. for Nuclear Research, Dubna, U.S.S.R.

Lab. of Theoretical Physics.

INVESTIGATION OF SUPERFLUID STATE OF ATOMIC NUCLEUS. V. G. Soloviev. 1959. 19p.

Variational principles developed in the theory of superconductivity were applied to the study of heavy nucleus properties. The energies of the ground superfluid state and a set of excited states for the case of an even and an odd number of nucleons on the shell were calculated. Changes of the ground nuclear state energy were calculated for a unitary change in the outer shell nucleons. (W.D.M.)

10546 AEC-tr-3586

ON THE ANALYTICAL CONTINUATION OF GENERALIZED FUNCTIONS. (Ob Analiticheskom Prodolzhenii Obobshchennykh Funktsii.) N. N. Bogolyubov and V. S. Vladimirov. CALCULATIONS IN THE REGION OF ANALYTICS: ADDENDUM TO THE ARTICLE ON "ANALYTICAL CONTINUATION OF GENERALIZED FUNCTIONS." (O Vychislenii Oblasti Analitichnosti: Dopolnenie k Rabote "Ob Analiticheskom Prodolzhenii Obobshchennykh Funktsii.") V. S. Vladimirov. Translated from a publication of the Joint Institute for Nuclear Research, Moscow, 1958. 69p. \$2.00(OTS).

The general theorem on the analytical character of the continuation of generalized functions of many variables is proved. The method of proof is such that it can also be easily applied in other cases. By means of this theorem, the basic theorem is proved. By this, the region of analysis is spread for all α from the interval $(0, 2\sqrt{2}\mu)$, when $M > 2\mu$. Several definitions and concepts are introduced. (W.D.M.)

10547

THE PROBLEM OF THE QUANTIZATION OF THE PROPER MASSES OF ELEMENTARY PARTICLES. Oliver Costa de Beauregard. *Compt. rend.* 248, 932-4(1959) Feb. 16. (In French)

The masses of elementary particles are, with integral or semi-integral coefficients, homogeneous linear functions of three mass quanta: the lepton m_1 ,

the meson m_π , and the baryon m_p , which have the relationship $1/137 : 1 : 13.4$. The quantum m_0 is connected to the gravitational field by removing the degree of freedom of the constant G . The universal role of the length quantum $l_0 = h/2 m_0 \approx 1.25 \times 10^{-13}$ cm is shown. (tr-auth)

10548

LAGRANGIAN FORMALISM FOR AN EXTENDED ISOLATED RELATIVISTIC PARTICLE. Francis Halbwachs and Jean-Pierre Vigiér. *Compt. rend.* 248, 934-7(1959) Feb. 16. (In French)

A general method for the formulation of a lagrangian formalism for the movement of an isolated relativistic particle possessing an internal structure defined by any number of vectors is given. The method is extended to the case of a lagrangian containing explicitly the total acceleration. (tr-auth)

10549

NUMBER OF INDEPENDENT SCALARS DETERMINED BY TENSOR MAGNITUDES. Philippe Leruste. *Compt. rend.* 248, 1121-3(1959) Feb. 23. (In French)

It is shown that the number of independent scalars I which can be formed by contracted multiplication beginning with the tensor magnitudes $T^{(i)}$ is given by $I = (\sum_i n_i p_i) - k$, where n_i is the number of independent components which determine the magnitude $T^{(i)}$, p_i is equal to 1 if the coordinates of $T^{(i)}$ are real and to 2 if the coordinates are complex, and k is determined by the number of covariant directions that $T^{(i)}$ defines. (J.S.R.)

10550

LAGRANGIAN OF A FREE RELATIVISTIC FLUID MASS. Francis Halbwachs and Jean-Pierre Vigiér. *Compt. rend.* 248, 1124-6(1959) Feb. 23. (In French)

The general formalism previously described (*Compt. rend.* 248, 934(1959)) is applied to a quadratic lagrangian containing an energy of rotation expressed in Einstein-Kramers variables. An expression generalizing correctly the classical expression is found for the angular moment. (tr-auth)

10551

A SYSTEM OF NONLINEAR WAVE EQUATIONS DESCRIBING A PARTICLE-FIELD MODEL OF SPIN 0 AND \hbar . Gérard Petiau. *Compt. rend.* 248, 1129-32(1959) Feb. 23. (In French)

A study is made of a system of nonlinear equations with partial derivatives of the first order describing simultaneously a particle and the field created by the particle source. The linear degenerations of the theory are either the wave equations of the particle with spin 0 or those of the particle with spin \hbar . (tr-auth)

10552

CAUSALITY IN A THEORY WITH AN INDEFINITE METRIC. D. A. Slavov and A. D. Sukhanov. *Doklady Akad. Nauk S.S.S.R.* 124, 1229-32(1959) Feb. 21. (In Russian)

The possible development of a theory of macro-causality with indefinite metric based on general approximations, within the limits of which are considered the previously published concrete variants, is investigated. (R.V.J.)

10553

THEORETICAL STUDY OF THE ELECTRON DISTRIBUTION IN A HETEROGENEOUS AND ANISOTROPIC LORENTZ PLASMA. Raymond Jancel and Theo Kahan (C.N.R.S., Paris). *J. phys. radium* 20, 35-42(1959) Jan. (In French)

A general expansion in spherical harmonics for the electronic distribution function is used to obtain a solution of the transport equation for a weakly ionized inhomogeneous (existence of density gradient) and anisotropic plasma (in the presence of electric and magnetic fields). This solution gives rise to a system of differential equations, and the solution of this system of equations gives the first two approximations to the distribution function. (auth)

10554

IN WHAT MEASURE CAN CLASSICAL MECHANICS PREDICT TRAJECTORIES? Max Born. *J. phys. radium* 20, 43-50(1959) Jan. (In French)

In view of the uncertainties concerning the initial conditions, due to inevitable experimental imprecision, the predictions of classical mechanics never describe a unique trajectory but rather a group of trajectories defined by a probability distribution. The true task of mechanics is to predict the evolution of this distribution with time. It is shown that for all cases, except for the harmonic oscillator, this distribution flattens out. In the case of periodic and quasi-periodic systems, any predictions concerning the configuration of the system considered become impossible beyond a critical value of the time. This critical value is easy to calculate as a function of the initial uncertainty. If the state of the system is described by angular variables φ and their conjugated action variables J , then, after a certain time a stationary limiting state is reached for which the J 's are nearly exactly determined while the φ 's are totally undetermined. This corresponds to the stationary state of the Bohr quantum theory, but here the J 's may take any values and not necessarily integral values of \hbar . These considerations do not affect the fundamental differences between classical and quantum mechanics. Their intention is solely to show that the idea of determination in classical mechanics is based on a hypothesis which is void of meaning and that the absence of determination in quantum mechanics cannot serve as an objection to this theory. (auth)

10555

POSSIBLE PARITY ASSIGNMENTS FOR THE STRANGE PARTICLES. John G. Taylor (Univ. of Maryland, College Park and Christ's Coll., Cambridge, Eng.). *Nuclear Phys.* 9, 357-70(1959) Jan. (1).

A general method is described which enables parities and coupling constants to be determined from angular distributions for strange particle processes. In particular from associated production of Λ and Σ particles by pions the relative parity of K^+ to K^0 seems quite conclusively to be odd, while the data are fitted best by K^+ having odd parity with respect to both the (ΛN) and the (ΣN) systems. Some inequalities between combinations of various coupling constants are also derived. (auth)

10556

ISOTOPE SHIFT AND CHANGES OF NUCLEAR RADIUS. A. R. Bodmer (CERN, Geneva). *Nuclear Phys.* 9, 371-90(1959) Jan. (1).

A new derivation of the expression for the nuclear charge distribution dependent isotope shift (I.S.) is given. This derivation shows clearly what approximations are made. The result, essentially the same as already obtained previously is as simple as the perturbation theory expression for the I.S. but is independent of the limitations of this. It depends on the charge distribution as a whole only through the root-mean-square radius, $\langle r^2 \rangle^{1/2}$, and on the difference of charge

distribution between isotopes only through $\delta \langle r^2 \rangle^{1/2}$. The implications of the electron scattering results for the I.S. are considered both for its dependence on $\langle r^2 \rangle^{1/2}$ and on $\delta \langle r^2 \rangle^{1/2}$. A renewed discussion is given of the effect of nuclear compressibility on the I.S. first considered by Wilets, Hill, and Ford. For this the dependence of the symmetry energy on the density is shown to be as important as the Coulomb energy. Thus the I.S. cannot be uniquely related to the compressibility coefficient of nuclear matter but may now however be used to obtain information about the density dependence of the symmetry energy. The implications of the I.S. data for changes of radius between isotones and between nuclei along the mass valley are also briefly considered. (auth)

10557

NON-LOCAL STRUCTURE OF QUANTIZED FIELD THEORIES OF THE SECOND KIND. W. Güttinger (Univ. of São-Paulo, Brazil). *Nuclear Phys.* **9**, 429-36 (1959) Jan. (1).

The transcendental vacuum expectation values arising from quantized field theories of the second kind are shown to impart to those theories a nonlocal structure which is characterized by an indeterminacy in space-time of the light-cone, indefinite metric in Hilbert space and noninvariance under similarity transformations in space-time. (auth)

10558

SCHEME OF QUANTUM MECHANICS WITH INDEFINITE METRIC. A. Uhlmann (Universität Jena, Ger.). *Nuclear Phys.* **9**, 588-95 (1959) Jan. (2). (In German)

The problem is examined how to change the axioms of quantum theory in order to introduce an indefinite metric. There are several inequivalent ways to divide the total Hilbert space of indefinite metric into two parts, one of which is of positive definite, the other of negative definite metric (so-called "physical" and "ghost-states"). In view of the arbitrariness in the choice of such decompositions the question is raised whether the completeness of the quantal description only requires the knowledge of the state-vectors and the hermitian operators belonging to the observables, or whether it is necessary to have further knowledge in order to privilege one mode of decomposition of the space into a positive and a negative part. In the paper, the second suggestion is denied. Every commuting system of hermitian operators points to a definite decomposition in a natural way, provided it is "large enough." We call "decomposing" every system of commuting operators which divides (in a certain sense) the total Hilbert space into a positive and a negative part. Not only does a decomposing system induce the decomposition, but there is associated with it a new positive definite metric of the total space. In this way a probabilistic interpretation is valid and the usual axiomatics is applicable. With respect to decomposing systems which induce the same decomposition, all results belonging to a quantum theory with positive definite metric are conserved. But there exists another case: the hermitian operator A may belong simultaneously to two decomposing systems S_1 and S_2 and the decomposition relative to S_1 may not agree with the decomposition relative to S_2 . Then, when analyzing a quantum state with the help of observables represented by operators belonging to S_1 , we may find an expectation value $\bar{A}^{(1)}$ different from the expectation value $\bar{A}^{(2)}$ of A with respect to an experiment that determines (in principle) the S_2 -observables. (auth)

10559

ON THE CONNECTION BETWEEN THE CLUSTER MODEL AND THE SU_3 COUPLING SCHEME FOR PARTICLES IN A HARMONIC OSCILLATOR POTENTIAL. B. F. Bayman and A. Bohr (Univ. of Copenhagen). *Nuclear Phys.* **9**, 596-9 (1959) Jan. (2).

It is shown that the cluster model of Wildermuth and Kanellopoulos provides an alternative description of certain states in the SU_3 coupling scheme of Elliott. (auth)

10560

THE EFFECTIVE NUCLEAR POTENTIAL. T. H. R. Skyrme (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Nuclear Phys.* **9**, 615-34 (1959) Jan. (2).

An empirical analysis is made of the mean effective internucleon potential required in the shell-model description of nuclei, allowing for the presence of many-body effects as suggested by current theory. A consistent description is found in which the effective two-body interaction acts almost entirely in even states, and the many-body effects are simulated by a repulsive three-body contact interaction. The strength of the two-body interaction is consistent with that expressed by the free scattering matrix of the two-nucleon system, and that of the three-body interaction with the "rearrangement energy" calculated in the many-body theory. (auth)

10561

SOME DISTORTION EFFECTS IN THE NUCLEAR p-SHELL. T. H. R. Skyrme (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Nuclear Phys.* **9**, 641-9 (1959) Jan. (2).

Some reasons are given for disliking the tensor-force explanation of the long lifetime of C^{14} . It is suggested that the composition of the ground state of N^{14} is influenced by distortion in such a way as to simulate the presence of a tensor interaction. Calculations made with a particularly simple form of unitary distortion operator give an effect of the correct sign and magnitude. (auth)

10562

QUANTAL DERIVATION OF MASS DEFECT. Gentaro Araki (Kyoto Univ., Yosida). *Nuclear Phys.* **9**, 650-1 (1959) Jan. (2).

It is shown that the mass defect phenomenon is expressible in the explicit form of the Pauli-type equation. (T.R.H.)

10563

ON THE SUPERFLUID STATE OF THE ATOMIC NUCLEUS. V. G. Soloviev (Joint Inst. of Nuclear Research, Dubna, USSR). *Nuclear Phys.* **9**, 655-64 (1959) Jan. (2).

The variation principle proposed by N. N. Bogolubov and the mathematical methods developed in the theory of superconductivity are employed to study the properties of the atomic nucleus. Weak interactions between protons (or neutrons) located in the same shell are treated on the basis of a nuclear model in which nucleons of the closed internal shells are assumed to produce a centrally symmetrical field which is somewhat distorted by nucleons in the outer shell. It is shown that the interaction between protons in an outer shell give rise to a superfluid state of the nucleus, the main role being played by interactions between protons with equal and opposite projections of the angular momenta on the nuclear symmetry axis. The energy of the ground

superfluid state and first excited state is evaluated and it is shown that in the case of an even number of protons in the shell, an energy gap between the superfluid and first excited states should exist, whereas, no such gap exists if the number of protons is odd. This permits one to explain the energy gap in heavy even nuclei. Conditions for the appearance of a superfluid state in an atomic nucleus have been obtained. They reduce to the requirement that attractive forces predominate between interacting protons located in the same shell near the Fermi surface energy. The critical temperature for the phase transition of a nucleus from the superfluid to normal state has been determined. (auth)

10564

DENSITY OF LOW-LYING PARTICLE LEVELS IN ODD-MASS NUCLEI IN THE REGIONS OF LARGE DEFORMATION. F. H. Bakke (NORDITA, Copenhagen). *Nuclear Phys.* **9**, 670-8(1959) Jan. (2).

From experimental level schemes the mean densities of low-lying levels formed by excitation of single particles are found for nuclei with odd Z and odd N in the regions $A = 153-185$ and $A = 231-245$. These level densities are nearly twice as high as those for a Fermi gas of nucleons where the interaction is taken into account only by using a constant effective mass $m^* = 0.7 m$. Such an increase in the density of the low-lying levels will be caused by a residual interaction between the nucleons at the top of the Fermi distribution. This effect may also be interpreted in terms of a pairing interaction between the nucleons. (auth)

10565

ON THE THEORY OF MULTIPLE SCATTERING. M. L. Ter-Mikayelian (Physical Inst. of the Academy of Sciences, Armenian SSR, Erevan). *Nuclear Phys.* **9**, 679-86(1959) Jan. (2).

A method for calculation of multiple scattering curves taking into account the finite dimensions of the nucleus is presented. Experimental results pertaining to scattering of fast electrons by nuclei are used in the calculations. (auth)

10566

ELECTRIC DIPOLE MOMENT ASSOCIATED WITH OCTUPOLE VIBRATIONS OF A SPHEROIDAL NUCLEUS. (ADDITIONAL REMARKS). Aage Bohr and Ben R. Mottelson (Univ. of Copenhagen and NORDITA, Copenhagen). *Nuclear Phys.* **9**, 687-8(1959) Jan. (2).

Corrections and additions to a previous article, (*Nuclear Phys.* **4**, 529-31(1957)) are offered. (T.R.H.)

10567

ON ANGULAR DISTRIBUTIONS IN COMPOUND NUCLEUS PROCESSES (ADDENDUM). T. Ericson (NORDITA, Copenhagen) and V. Strutinsky (Universitetets Inst. for Teoretisk Fysik, Copenhagen). *Nuclear Phys.* **9**, 689-90(1959) Jan. (2).

10568

ON THE THEORY OF HIGHER SPIN FIELDS. C. Fronsdal (Univ. of California, Los Angeles). *Nuovo cimento* (10) **9**, Suppl. No. 2, 416-43(1958).

Recent experiments on strange particles have given some support for the possibility that elementary particles of spin higher than 1 may exist. In particular the observed angular correlation between the planes of production and decay of the Λ and Σ hyperons and the anisotropy of the angular distribution of the Σ decay products seem to indicate that the spins of these particles are $3/2$ or higher. A new simple formulation of

the Fierz-Pauli theory is presented, and the structure of this theory for arbitrary spin is analyzed in some detail. All relativistic theories of free fields are based on the principle of invariance under the group of coordinate transformations known as the Lorentz group. Conditions for definition of mass and spin are formulated in terms of conditions on the wave functions, in the case of no external forces. A spin projection operator is introduced, which greatly simplifies the treatment of the subsidiary conditions. The Fierz-Pauli theory for electromagnetic interaction of particles of arbitrary spin is analyzed with the aid of the spin projection operator. Polarization operators are introduced and applied to the calculations of angular distribution of hyperon decay products. (W.D.M.)

10569

STUDIES OF THE SPHERICAL HARMONICS METHOD IN NEUTRON TRANSPORT THEORY. W. Kofink (Inst. of Tech., Karlsruhe, Ger.). *Nuovo cimento* (10) **9**, Suppl. No. 2, 497-531(1958).

Contrary to some statements which have been made, the spherical harmonics method and the Gauss quadrature method dealing with the monoenergetic transport equation are not identical. Basically the Gauss quadrature method, as applied to the Milne problem, is a non-analytic approximation, whereas all functions used in the spherical harmonics method are continuous. The relation between these two methods are examined in detail. The Milne problem with p-wave scattering is used as a convenient example for the analysis. General spherical harmonics solutions to the Milne problem are derived and compared with the Gauss quadrature solutions. (W.D.M.)

10570

A MONTE-CARLO METHOD TO CALCULATE MULTIPLE PHASE SPACE INTEGRALS. I. F. Cerulus and R. Hagedorn (CERN, Geneva). *Nuovo cimento* (10) **9**, Suppl. No. 2, 646-58(1958).

In the region of primary energies of the order of 1 to 100 Bev, the number of particles created in a collision is of 1 to 10. Consequently, pure thermodynamical calculations fail and if one wished to apply a theory like Fermi's the phase space integrals must be calculated. The physical side of the problem, i.e., the validity of this type of theory is not considered. An attempt is made to solve the mathematical problem of calculating the phase space integral, which has not been achieved in a simple and reliable manner so far. The exact spectra phase space density should be useful in extracting from future experiments of suitable representation of the matrix elements of interaction by simple functions of energy, number of particles, etc. (W.D.M.)

10571

A MONTE-CARLO METHOD TO CALCULATE MULTIPLE PHASE SPACE INTEGRALS. II. F. Cerulus and R. Hagedorn (CERN, Geneva). *Nuovo cimento* (10) **9**, 659-77(1958).

The previously proposed Monte Carlo calculation can be done only on automatic computers and of course only with a limited accuracy. Error estimates, flow diagram, practical experiences, and estimates of computing time are discussed. A comparison with the usual approximation methods is given. (W.D.M.)

10572

ON THE RENORMALIZATION OF A PARITY NON-CONSERVING INTERACTION. K. Sekine (Univ. of Tokyo). *Nuovo cimento* (10) **11**, 87-101(1959) Jan. 1.

An exact formulation is given of the renormalization method in a parity nonconserving theory. Equations determining the renormalization constants are obtained, and, among other things, the internal consistency of the theory is examined. (auth)

10573

THEORY OF RADIATIVE DAMPING IN STATIONARY STATES. C. A. Mead (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **112**, 1843-7(1958) Dec. 15.

A formalism is developed for finding the stationary states of systems for which radiative damping effects must be considered. The method includes a criterion for deciding whether or not a given unperturbed state has an exact stationary state corresponding to it. The method is applied to a simple example, the Lee model with unstable V particle, and it is indicated how more complicated problems may be treated. (auth)

10574

FISSION NEUTRON SPECTRA AND NUCLEAR TEMPERATURES. James Terrell (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* **113**, 527-41(1959) Jan. 15.

It is shown that Weisskopf's nuclear evaporation theory, when allowance is made for the expected distribution of nuclear temperatures of fission fragments, predicts an essentially Maxwellian distribution of fission neutron energies in the laboratory system. This is found to be in excellent agreement with all available data. On the assumption that neutron emission is symmetrical about 90° in the center-of-mass system, the average \bar{E} of the fission neutron energy spectrum should be $\bar{E} = \bar{E}_f + 2T$, in which E_f and T are the average values of the fission fragment energy per nucleon and the nuclear temperature. Experimentally, $\bar{E}_f \approx 0.78$ Mev for all cases reported, giving fission fragment nuclear temperatures of 0.6 to 0.7 Mev for measured fission neutron spectra. This gives $a = 12 \pm 2$ Mev $^{-1}$ for the equation $E_e = aT^2 =$ excitation energy. The same concepts lead to the prediction $\bar{T} \approx \frac{2}{3}[(\bar{\nu} + 1)E_0/2a]^{1/2}$, or $\bar{E} \approx 0.78$ Mev + $0.621(\bar{\nu} + 1)^{1/2}$ for U^{235} ; n ; E_0 is the excitation energy change per emitted neutron, about 6.7 Mev, and $\bar{\nu}$ is the average number of neutrons emitted per fission. This equation, which is approximately valid for all present experimental data, leads to the prediction that $d\bar{E}/dE_x \approx 0.025$ for U^{235} (E_x is the excitation energy of the fissioning nuclide). The center-of-mass energy spectrum of fission neutrons was calculated, as well as effects of anisotropy of emission on the laboratory fission neutron spectrum. (auth)

10575

EFFECTIVE CHARGE OF NEUTRONS IN NUCLEI. A. de-Shalit (CERN, Geneva). *Phys. Rev.* **113**, 547-51(1959) Jan. 15.

The polarization of closed proton shells by neutrons can be considered as inducing an effective charge on the neutron for some multipoles but not for others. The rough constancy of the effective neutron charge as observed in $E2$ transitions and quadrupole moments in nondeformed odd N -even Z nuclei is discussed, and arguments are presented to explain this phenomenon along the lines of the shell model. (auth)

10576

HYDRODYNAMIC THEORY OF SPONTANEOUS FISSION. W. D. Foland and R. D. Present (Univ. of Tennessee, Knoxville). *Phys. Rev.* **113**, 613-21(1959) Jan. 15.

The penetration factor for spontaneous fission was

calculated from the liquid-drop model. The transformation of the Gamow integral over the nucleon coordinates into an integral over the deformation parameters a_n was carried out hydrodynamically, assuming irrotational motion. The transformation requires evaluation of the kinetic energy in terms of a_n and \dot{a}_n . Series expansions are used for the kinetic energy and for the potential energy of deformation. All parameters were neglected but a_2 and the hydrodynamic calculations were carried through terms in a_2^4 . While the potential barrier is subject to several uncertainties, it was nevertheless possible to estimate the spontaneous fission hindrance factor for the highest Z elements. It is found for $Z = 100$ and $Z^2/A \approx 39$ that a 1-Mev increase in barrier height should correspond to a $10^{3.7}$ -fold increase in the half-life. This result agrees closely with the empirical hindrance factor formula deduced by Swiatecki from a correlation of fluctuations in half-lives with deviations of ground-state masses from the semiempirical mass formula. Some details of both the hydrodynamic and the electrostatic calculations are included. (auth)

10577

β - γ CORRELATIONS IN THE FIRST FORBIDDEN TRANSITION. Tsuneyuki Kotani and Marc Ross (Indiana Univ., Bloomington). *Phys. Rev.* **113**, 622-7(1959) Jan. 15.

A discussion is given of the theory of β - γ correlations in the unique and nonunique first forbidden transition. In particular, numerical results are presented for the Coulomb corrections to the β - γ directional correlation and transverse β polarization- γ correlation. The energy dependence of the contribution associated with violation of time-reversal invariance is given. (auth)

10578

EQUATIONS OF MOTION OF POINT PARTICLES IN FIELDS OF NONZERO REST MASS AND SPIN. Peter Havas (Lehigh Univ., Bethlehem, Penna.). *Phys. Rev.* **113**, 732-40(1959) Jan. 15.

A classical theory of free fields corresponding to quanta of arbitrary integral spin has been formulated by Dirac and Fierz. Sources of such neutral fields were considered by Harish-Chandra, who also obtained the equations of motion for arbitrary multipole singularities. It is noted that for fields of nonzero rest mass and spin the conditions imposed on the sources by Harish-Chandra are more stringent than is required by the invariance properties of the fields, and a more general set of equations is proposed. The corresponding equations of motion are obtained for arbitrary multipole singularities. The theory is extended to charged and charge-symmetric fields. (auth)

10579

THE ROLE OF THE LOCALIZED STATE OF THE BETHE-GOLDSTONE EQUATION. Gerhart Lüders (Max-Planck-Institut für Physik und Astrophysik, München). *Z. Naturforsch.* **14a**, 1-5(1959) Jan. (In German)

As recently pointed out by Gottfried, localized solutions of the Bethe-Goldstone equation can possibly affect the consistency of the Brueckner treatment of the many body problem. In the present paper the same problem is taken up from a different point of view by indicating the place where an inconsistency occurs in the lowest order or in higher orders of the Goldstone

analysis. Localized states of pairs of particles "in nuclear matter" seem just as dangerous as those of more particles. (auth)

10580

THE PARTICLE-HOLE TRANSITION IN SYSTEMS OF ALMOST INDEPENDENT FERMI PARTICLES.

Gerhart Lüders (Max-Planck-Institut für Physik und Astrophysik, Munich). *Z. Naturforsch.* **14a**, 5-7(1959) Jan. (In German)

The particle-hole relation in systems of nearly independent Fermions becomes more natural and transparent if it is chosen as an anti-linear relation. (auth)

10581

ON THE SCATTERING MATRIX IN AN INDEFINITE METRIC. L. A. Maksimov. *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 465-73(1959) Feb. (In Russian)

A method is suggested which, in the theory with an indefinite metric, excludes all nonphysical states from the initial and final states of the system. The method is applied to the Lee model and scalar photon model. (auth)

10582

RENORMALIZATION OF THE VERTEX PART IN PSEUDOSCALAR MESON THEORY. V. N. Gribov. *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 554-9(1959) Feb. (In Russian)

Renormalization of the vertex part in pseudoscalar meson theory is studied with the aid of spectral representations for the mean (with respect to vacuum) of the T product of the three Heisenberg operators. The problem of the magnitude of the renormalization constants is discussed. An expression for Z_1 in terms of the spectral functions is found and the relation between these spectral functions and the spectral functions in the Källen-Lehman representations for a single-particle Green's functions is established. (auth)

10583

ON THE SYMMETRY PROPERTIES OF SCHRÖDINGER EQUATION INNATE FUNCTIONS. D. A. Bochvar, N. P. Gambaryan, I. V. Stankevich, and A. L. Chistyakov (Inst. of Organic Element Compounds, Academy of Sciences, U.S.S.R.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 626-7(1959) Feb. (In Russian)

The fact that the symmetry group of the Schroedinger equation innate functions are the subgroups of G_H symmetry in the corresponding Hamiltonian and the erroneous contradicting assertion that such G_H subgroups are not symmetry groups of the Schroedinger innate functions are discussed. (R.V.J.)

10584

SELECTED PAPERS ON QUANTUM ELECTRODYNAMICS. Julian Schwinger, ed. New York, Dover Publications, Inc., 1958. 423p. \$2.45.

Thirty four papers on the significant developments in quantum electrodynamics are presented. The papers cover a period from about 1927 to 1953. (W.D.M.)

10585

THEORY AND APPLICATIONS OF NUCLEAR INDUCTION. Ajit Kumar Saha and Tara Prasad Das. Calcutta, Saha Institute of Nuclear Physics, 1957. 530p.

The phenomenological theory and the experimental techniques are discussed in detail in the first three chapters. The subsequent four chapters are devoted to a less detailed discussion of the characteristics of

resonance patterns, line breadth, relaxation time, nuclear quadrupole effects, chemical shifts, systematic errors inherent in measurements of magnetic moments, etc., with enough examples to give a clear idea of the underlying principles of these features. (W.D.M.)

RADIATION EFFECTS ON MATERIALS

10586 AECU-4056

Georgia Inst. of Tech., Atlanta, Engineering Experiment Station.

RADIATION CHEMISTRY OF ORGANIC SUBSTANCES.

Final Report for January 1, 1957 to January 31, 1959.

James A. Knight, Jr. Jan. 31, 1959. 38p. For Oak Ridge National Lab. Project No. A-323. Contract W-7405-eng-26, Subcontract 1082. \$6.30(ph), \$3.00(mf) OTS.

The chemical processing of reactor fuels involves the use of organic substances as extracting agents and as diluents. When most organic substances are exposed to reactor fuels, radiation damage occurs. The objectives of this project were to provide more information regarding radiation damage to hydrocarbon solvents which are similar to those used as diluents in the Thorex Process and to determine if the radiation-damage diluent has a pronounced deleterious effect upon the extraction process. (W.L.H.)

10587 NP-7322

New York Univ., New York.

RESEARCH ON SOLID STATE RADIATION-INDUCED PHENOMENA. Quarterly Progress Report No. 3 [for] October, November, December [1958]. Hartmut Kallmann. Feb. 1959. 74p. Contract DA-36-039-SC-75043.

Light and High Energy Induced Energy Transfer in Liquid and Rigid Organic Scintillators. Three modes of energy transfer are considered: material diffusion, energy migration, and single-step transfer. Comparison of fluorescence induced by light excitation of the solute with that produced by light excitation of the solvent with various wavelengths shows that energy transfer in some solution is very efficient, approaching 100%. It is further found that energy transfer produced under high energy excitation is identical to that produced under light excitation of the solvent, and that in both cases it occurs from the lowest excited state of the solvent. Investigations of quenching and energy transfer in rigid media make possible a discrimination between the three processes. Glow Curve Measurements. Rise curves of fluorescence at liquid nitrogen temperature and glow curves obtained by heating after the cessation of excitation were measured for ZnS:Cu, ZnS:Ag and ZnS:Cu + Pb phosphors under excitation by ultraviolet or β -rays. Deficiency areas and glow curve areas were calculated. In most of the cases the latter is larger than the former. The Effects of Electric Fields on the Luminescence of ZnS Phosphors. Experiments are described on two copper-activated zinc sulfides: non-electroluminescent powder M, and electroluminescent powder EL-1. These powders are embedded in a castor-wax matrix and in a tricresyl phosphate matrix. They are subjected to pulsed d-c and square wave fields—powder EL-1 in the dark and powder M under either 3650 Å or 2500 Å ultraviolet excitation. The electroluminescent light peaks from EL-1 and the electrophotoluminescent peaks

exhibited by powder M are both related to the internal fields within the grains. The persistence of the internal fields was measured and found to be modified strongly by the polar tricresyl phosphate matrix, and by the influence of external radiation. (For preceding period see NP-7179.) (auth)

10588 RDB(C)/TN-48

Gt. Brit. Culcheth Labs., Culcheth, Lancs, England. THE EFFECT OF FISSION PRODUCT ACCUMULATION ON THE PHYSICAL CONDITION OF FAST REACTOR FUEL ELEMENTS. K. Q. Bagley and D. S. Oliver. July 17, 1953. Decl. Nov. 20, 1957. 36p. (FRDC/P-41).

Data are presented on the chemical, physical, and alloying characteristics of the fission products likely to be formed in the fast reactor. The distribution of these fission products at the end of 40,000 Mwd irradiation is discussed, together with some of the consequences of their formation. Recommendations are made for the investigation of the expected phenomena and for the development of fuels which are less likely to undergo severe irradiation damage. (auth)

10589 TID-7565(Pt. 1)

Division of Reactor Development, AEC and United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England. US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. I. F. Zartman and G. B. Greenough, eds. Mar. 16, 1959. 160p. \$1.75(OTS).

Discussions are presented on the effect of radiation on graphite and gas-graphite reactions. Separate abstracts have been prepared for each paper. (W.L.H.)

10590 TID-7565(Pt. 1)(p.1-10)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DIMENSIONAL CHANGES IN IRRADIATED GRAPHITE. E. M. Woodruff. p.1-10 [of] US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. 10p. (HW-55821).

Studies of the irradiation stability of graphites have been made in support of the design and operation of Hanford reactors. Portions of these studies pertaining to dimensional changes in irradiated graphite are discussed. Two types of reactor-grade graphite irradiated at low and high temperatures provide data demonstrating the effects of fabrication and irradiation variables. Studies of experimental graphites demonstrate the possibility of tailoring irradiation stability during fabrication. Mechanisms for length changes in graphite resulting from irradiation at low and high temperatures and the results of annealing property changes are discussed. (auth)

10591 TID-7565(Pt. 1)(p.11-20)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

STORED ENERGY IN IRRADIATED GRAPHITE. J. M. Davidson. p.11-20 [of] US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. 10p. (HW-55736).

The effect of temperature and exposure on stored-energy accumulation in graphite resulting from neutron irradiation is discussed. Although stored energy accumulates progressively with exposure, the effect of temperature of exposure is much more pronounced. Temperatures of exposure in excess of 300°C result in

very little stored energy. The data presented include the effect of exposure temperatures to 750°C and exposures to 5000 MD/CT. X-ray measurements of C_0 and L_c are included for some samples mentioned in this work. (auth)

10592 TID-7565(Pt. 1)(p.21-32)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

IRRADIATION ANNEALING IN GRAPHITE. I. AN EXPERIMENTAL STUDY. R. E. Nightingale. p.21-32 [of] US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. 12p. (HW-55274).

Graphite samples were irradiated in a high-temperature irradiation facility to determine whether reactor annealing is a separate phenomenon or due merely to long-term thermal annealing. Several groups of reactor grade graphite samples with 2366 MD/CT, 1455 MD/CT, 1404 MD/CT, and 651 MD/CT exposures at 30°C were thermally annealed at 375°C for several days and then charged into the reactor. They were exposed for several periods at approximately 335°C to a total exposure of 1504 MD/CT. Property measurements were made on the samples following the cooled test-hole irradiations, the thermal anneals, and each period of high-temperature reactor exposure. Properties measured were sample length, C_0 spacing, electrical resistivity, thermal conductivity, and in some cases total stored energy. A second set of samples with cooled test-hole irradiations of 1177 MD/CT, 950 MD/CT, and 329 MD/CT were also thermally annealed at 375°C for several days, but were then subjected to a long-term thermal anneal at the same temperature (335°C) as the samples in the reactor. The same property measurements were made on this set of samples. The results of these experiments show that the observed reactor annealing cannot be interpreted as due to long-term thermal annealing. Processes that occur during the annealing of irradiation damage in graphite are distributed over a wide range of activation energies. During thermal annealing only a relatively narrow band of activation energies participate at any instant. A wide range of energies contribute to the irradiation annealing process at any instant, and, as a result, property changes occur over a long period of time. Differences in the distribution of damage following thermal anneals and irradiation anneals are discussed. Irradiation annealing at 335°C is effective in partially removing damage out to regions only reached by thermal annealing to 1300°C. (auth)

10593 TID-7565(Pt. 1)(p.33-45)

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

A PRELIMINARY ANALYSIS OF RADIATION DAMAGE GRADIENTS IN MODERATOR GRAPHITE. Robert L. Carter. p.33-45 [of] US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. 13p.

Consideration is given to the nature of the thermal conductivity of graphite, and to the theory of fast neutron induced irradiation damage. From this it is possible to infer the temperature dependence of thermal conductivity at all stages of irradiation damage. Based upon this inference and published experimental determinations of the irradiation effects sustained by graphite as a function of irradiation temperature, the steady state temperature distribution at a cooled graphite moderator surface is derived for the case of planar heat flow. (auth)

10594 TID-7565(Pt. 1)(p.46-63)

Brookhaven National Lab., Upton, N. Y.

CONTROL OF RADIATION DAMAGE IN A GRAPHITE REACTOR STRUCTURE BY ANNEALING. R. W. Powell. p.46-63 [of] US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. 18p.

In 1947, when the Brookhaven National Laboratory (BNL) graphite research reactor was being designed, information available on radiation damage in graphite structures was meager but had indicated that dimensional instability was to be expected at high neutron flux levels and, further, that greatest dimensional changes were to be expected in directions perpendicular to the axis of extrusion of the graphite bars. Prior to presenting the data on graphite-growth annealing procedures and results, a brief résumé is made of the type of graphite used in the reactor, the manner in which it was placed in the structure, the design of the surrounding shield, the spectrum of the radiation to which the structure is subjected, and methods and apparatus employed in obtaining the physical growth measurements. Each of the above-mentioned items has influenced our results, and, to correlate these gross-structure data with laboratory information or information gathered on other reactor structures, the extent of these influences must be considered in detail. (auth)

10595 TID-7565(Pt. 1)(p.64-81)

Oak Ridge National Lab., Tenn.

EVALUATION OF THE ORNL GRAPHITE REACTOR. M. C. Wittels. p.64-81 [of] US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. 18p.

Measurements on X-10 pile graphite have been conducted at various laboratories. At each of the laboratories, different methods of measurement were employed so that independent analysis would be available. The samples were cored from the most severely damage region of the graphite stack for the purpose of determining the most serious situation that exists. The measurements were designed to determine the validity of C_0 spacing correlations in stored-energy estimates which have been employed in evaluating the state of the reactor. (W.L.H.)

10596 TID-7565(Pt. 1)(p.82-7)

United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England and United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

EXPERIMENTAL METHODS FOR DETERMINING STORED ENERGY. J. C. Bell and J. H. W. Simmons. p.82-7 [of] US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. 6p.

Four methods are presented for determining stored energy in graphite. These methods are the dipping technique, adiabatic rise, linear rise, and heat of combustion. (W.L.H.)

10597 TID-7565(Pt. 1)(p.88-101)

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

IRRADIATION DAMAGE IN GRAPHITE. J. H. W. Simmons. p.88-101 [of] US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. 14p.

Data are presented on stored energy, growth, and some other physical properties of irradiated graphite. (W.L.H.)

10598 TID-7565(Pt. 1)(p.102-10)

United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England. STORED ENERGY IN PILE IRRADIATED GRAPHITE. J. C. Bell and G. B. Greenough. p.102-10 [of] US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. 9p.

The data presented have been obtained from graphite irradiated in channels running through the moderator structure parallel to the fuel channels at the center of the lattice. This graphite has been employed primarily for monitoring purposes; no temperature control has been possible during the irradiations and there have been some variations in the quoted average values during the course of the irradiations. In some cases the specimens have been left in the pile during the periodic pile anneals and this fact is noted on the figures. In these cases the total integrated thermal flux (BEPO equivalent) given to the specimens is quoted; in general the integrated flux since the last anneal is roughly 15 per cent of the quoted value. Because of the method used to anneal the pile, however, there is no certainty that any particular specimen was effectively annealed at any particular time. (auth)

10599 TID-7565(Pt. 1)(p.115-20)

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

ON THE PROPAGATION OF THERMAL WAVES IN MEDIA WITH STORED ENERGY. A. J. E. Foreman. p.115-20 [of] US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. 6p.

Solutions of the heat conduction equation are given for a medium in which stored energy may be released in the form of heat over a certain temperature range; the rate of release of heat is described by several possible types of kinetics. These solutions represent one-dimensional thermal waves propagating with a constant velocity that depends directly on the form assumed for the kinetics of the heat release process. The release of stored energy that is controlled by a single activation energy and frequency factor is considered in detail, and the results are used to make a preliminary estimate of the velocity of a thermal wave in irradiated graphite. (auth)

10600 TID-7565(Pt. 1)(p.121-32)

Brookhaven National Lab., Upton, N. Y. THE EFFECT OF RADIATION ON THE RATE OF OXIDATION OF GRAPHITE. W. L. Kosiba and G. J. Dienes. p.121-32 [of] US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. 12p.

The purpose of this investigation was to determine the influence of radiation-induced lattice defects and the effects of various types of radiation on a gas-solid reaction. The results are of practical interest for graphite-moderated reactors. The graphite-oxygen reaction was studied over the temperature range 250 to 450°C. Graphite samples were irradiated in the Brookhaven Reactor, and the oxidation was studied subsequently by measuring the weight loss as a function of time in a stream of oxygen or air. An exposure of 4×10^{20} neutrons/cm², which produces about 2 per cent

displaced atoms at room temperature, increases the rate of oxidation by about a factor of 5 to 6 relative to the unirradiated samples. The oxidation rate of untreated samples in the presence of high-intensity gamma rays (600,000 r/hr) is significantly increased. The reaction rate of samples previously irradiated (4×10^{20} neutrons/cm²) in the reactor and oxidized in the presence of gamma rays (200,000 r/hr) at 300°C is higher by an additional factor of about 4, i.e., a factor of about 20 relative to unirradiated specimens. It is concluded that displaced atoms exert a larger influence on the rate of this heterogeneous gas-solid reaction. When, in addition, ionizing radiation is present during the reaction, the rate is further increased, probably because of the ionization of oxygen molecules. The oxidation of virgin graphite inside the Brookhaven Reactor was performed at two different fluxes (2×10^{12} and 6×10^{12} neutrons/cm²/sec) at 250, 300, 350, and 400°C. At 250 and 300°C the rates at the higher flux are 20 to 30 times higher than those of virgin graphite oxidized in the absence of radiation. However, at 350 and 400°C, not only are the rates lower than those at 300°C in the higher flux but they are lower by a factor of about 6 than those for virgin graphite oxidized in the absence of any radiation field: This inhibition of the oxidation reaction in the reactor at the two higher temperatures is a well reproducible result. The explanation for this inhibition is not known at the present time. Whenever air is used as an oxidant, the rates are lower than with pure oxygen by a factor of 2 to 4.

(auth)

10601 TID-7565(Pt. 1)(p.133-40)
Argonne National Lab., Lemont, Ill.
EFFECT OF RADIATION ON THE OXIDATION OF GRAPHITE SINGLE CRYSTALS. G. R. Hennig. p.133-40 [of] US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. 8p.

Irradiated graphite crystals burn at a higher rate than unirradiated crystals. The increase appears to be due to a different mode of attack by oxygen. Unirradiated crystals are attacked at crystal edges and crystal steps only, while irradiated crystals burn at all surfaces, and in consequence become covered with minute pits visible in the microscope. The cause for this pit formation is not catalysis; very probably the cause is enhanced reactivity at lattice defects. (auth)

10602 TID-7565(Pt. 1)(p.141-7)
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE OXIDATION OF GRAPHITE DURING IRRADIATION IN OXYGEN. J. Wright. p.141-7 [of] US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. 7p.

The work was carried out in a hollow fuel element in BEPO. The graphite samples were contained in a silica U-tube connected to a bulb of 2.6 liter capacity, also in the neutron flux, and through which the gas normally passed before reaching the specimens. The gas system was of a circulating type, and CO₂ analysis depended on the periodic freezing out of the CO₂ from the circulating gas. Carbon monoxide analyses were also made at intervals on gas samples. Results are expressed in terms of micromoles of CO₂ formed per hour. The rates of CO₂ evolution during irradiation showed a complex dependence on the oxygen pressure, flow rate, and reactor power. (W.L.H.)

10603 TID-7565(Pt. 1)(p.148-56)
United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England.
THE REACTION OF GRAPHITE WITH GASEOUS COOLANTS IN THE WINDSCALE AND CALDER REACTORS. J. S. Nairn and P. J. Robinson. p.148-56 [of] US/UK GRAPHITE CONFERENCE HELD AT ST. GILES COURT, LONDON, DECEMBER 16-18, 1957. 9p.

The oxidation rates of Windscale Pile 1 graphite are plotted. Some results on the graphite-CO₂ reactions in Calder Reactors are reported. (W.L.H.)

10604 WADC-TR-58-206
Stanford Research Inst., Menlo Park, Calif.
EFFECTS OF HIGH ENERGY, HIGH INTENSITY ELECTROMAGNETIC RADIATION ON ORGANIC LIQUIDS. [Period covered]: May 1, 1957 to April 30, 1958. Robert M. Wagner and Leland H. Towle. June 1, 1958. 51p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: EFFECTS OF NUCLEAR RADIATION. Contract AF33(616)-3738. (AD-202499).

Materials employed for practical nuclear power applications must possess optimum resistance to radiation effects on their molecular structure. Although certain radiation effects are considered beneficial, the majority are degradative to an unacceptable degree at high dose levels. The functions of hydraulic and lubricating fluids in nuclear power auxiliary equipment are cases in point. These fluids must maintain viscosity and flash point at optimum levels. A knowledge of the effects of molecular structural characteristics upon radiolytic stability of organic materials is needed to aid in the efficient design of radiation-resistant equipment. Some materials may of necessity be located in a high flux density radiation field. This study attempts to provide, through the study of several representatives of different types of organic structure, background information which may suggest methods of judicious choice for a given application. The following compounds were subjected to high energy electron bombardment: alkyl aromatic hydrocarbons, aromatic ethers, nitro aromatics, amino aromatics, and aliphatic mixed ether-alcohol types. Quantitative measurements were made of the amounts and types of radiolytic products formed. Inferences were drawn from such measurements concerning the relative stability of compounds, and the influence of functional groups upon such stability. Higher molecular weight compounds in general, and condensed aromatic ring systems in particular, are the most resistant to radiation. Aliphatic or heterophatic linkages between aromatic ring systems are sites of primary radiolytic scission. The extent to which species of higher molecular weight than parent material are formed is directly dependent upon the fate of the initial products of the scission of each radiolytically labile linkage. The primary products of scission may hydrogenate and revert to stable form; if energetic enough, they may attack parent material; or they may condense with each other producing products comparable to the parent in molecular weight. Compounds possessing the ability to assume certain spatial configurations, allowing resonance effects to exist, may permit absorbed energy to be innocuously reduced to levels which are below that required to rupture the molecular structure. The presence of different functional groups on aromatic ring systems markedly influence the mode of radiolytic scission. These differ-

ences are reflected in either gas yield, polymer yield, or both. The data do not permit complete and unequivocal definition of either the mode of radiolytic decomposition or the delineation of the structure of all products detected. (auth)

10605 NP-tr-223

THE EFFECTS OF GAMMA RAY IRRADIATION ON A SOLID CATALYST. Kozo Hirota, Shigeru Sakuyama, and Gisuke Y. Meshitsuka. Translated for U.K.A.E.A., Atomic Energy Research Establishment from Nippon Kagaku Zasshi 78, 981-2(1957). 8p. \$1.80(ph), \$1.80(ms) JCL or LC.

Experiments in which irradiated vanadium oxide was used as a catalyst are discussed. In the oxidation of sulfurous acid the catalytic action of V_2O_5 was observed to deteriorate. It is pointed out that more extensive investigation is necessary before any conclusions can be drawn. Experimental procedures are described, and a diagram of the apparatus used is included. (J.R.D.)

10606

THE EFFECTS OF ENERGETIC RADIATION ON METAL ADHESIVES. A. Matting and K. F. Hahn (Technischen Hochschule, Hanover). Atomkernenergie 4, 64-7(1959) Feb. (In German)

The mechanical properties of adhesives can be altered by a strong radiation. It influences with preference the degree of reticulation in strengthening or loosening its molecular forces. Each adherent seems to be lacking in an optimum dose of rays in order to reticulate most effectively. Because of the different distribution of stresses in a sticked lap joint not only the modulus of elasticity of the connecting layer, but also the strength of the joint will be affected. It should be observed that a strong radiation causes a less drooping stress-strain curve of the glutinant, giving thereby an elevated shear strength at higher temperatures. (auth)

10607

THE DISCOLORATION OF GLASS BY IONIZING RADIATION. I. Kügler (Univ. of Giessen, Ger.). Atomkernenergie 4, 67-72(1959) Feb. (In German)

Glass is discolored under the action of high-energy radiation. For usual purposes glasses resistant to radiation effects are desired. Glass sensitive to radiation effects, however, can be used for dosimetry. The discoloration of silicate, lead, and phosphate glasses, some having cerium admixture, is investigated under the influence of ionizing radiation. Some of these glasses were found suitable for dosimetry. (auth)

10608

EFFECT OF HIGH ENERGY ELECTRON BOMBARDMENT OF THE CONDUCTIVITY OF GERMANIUM. N'Guyen Van Dong, Lydie Koch, Pierre Baruch, and Pierre André. Compt. rend. 248, 788-91(1959) Feb. 9. (In French)

An anomaly of the electron-voltaic effect in a Ge connection bombarded by 2-Mev electrons at 100°K is announced. (tr-auth)

10609

EFFECT OF NUCLEAR PARTICLE BOMBARDMENT ON STRESSES AND SMALL DEFORMATIONS IN SOLIDS. Yu. I. Remnev (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 124, 540-1 (1959) Jan. 21. (In Russian)

The relation between stress and deformation in

crystalline solids during radioinduced volume expansion was investigated. The investigation was limited to a few specific effects described by simplified hypothesis. It is assumed that in neutron bombardment the isotropy of materials remains undisturbed and the single atom volume expansion $\theta(r,t)$ is considered to be the result of Frenkel defects, thermal effects, and effects of nuclear transformation. In addition to the elastic scattering, the reaction (n,f) is studied with the assumption that each nuclear fission is followed by production of only single chemical elements and the released energy in each fission act is equal. (R.V.J.)

10610

THE EFFECT OF IONIZING RADIATION ON CARBOHYDRATES. THE IRRADIATION OF SUCROSE AND METHYL α -D-GLUCOPYRANOSIDE. M. L. Wolfrom, W. W. Binkley, and Leo J. McCabe (Ohio State Univ., Columbus). J. Am. Chem. Soc. 81, 1442-6(1959) Mar. 20.

The effects of cathode radiation on 50% aqueous solutions and powdered samples of sucrose and methyl α -D-glucopyranoside are reported. The extent of hydrolysis of aqueous sucrose (based on the amount of invert sugar formed) increased with increasing irradiation dosage and at 104 megareps was 22.2, 27.0 and 37.8% while being cooled with ethanol-(solid carbon dioxide), ice and water, and ambient air, respectively. Evidence was obtained that about 10% of the sucrose (at all three temperatures) was transformed into non-reducing substances. The product of irradiated 50% aqueous sucrose contained D-glucose and D-fructose, the latter being identified by paper chromatography and the former by an isolated derivative. Powdered sucrose was irradiated at ambient air and ice-water temperatures. The extent of hydrolysis of powdered sucrose as a function of dosage reached a maximum at an intermediate dose. This effect was more pronounced in the samples cooled with ambient air. Powdered and 50% aqueous samples of methyl α -D-glucopyranoside, irradiated with 104 megareps at ice-water temperature, hydrolyzed to the extent of 3.3 and 6.3%, respectively (based on conversion to D-glucose). Evidence from paper chromatography indicated the formation of substantial amounts of D-glucose. G(invert sugar) values for irradiated sucrose and G(glucose) values for irradiated methyl α -D-glucopyranoside were calculated. (auth)

10611

IRRADIATION EFFECTS IN SIMPLE ORGANIC SOLIDS. R. S. Alger, T. H. Anderson, and L. A. Webb (U. S. Naval Radiological Defense Lab., San Francisco). J. Chem. Phys. 30, 695-706(1959) Mar.

The color centers and free radicals produced in irradiated solid alcohols, ketones, ethers, and other compounds have been examined experimentally by means of optical absorption and EPR spectroscopy to obtain information regarding the products of ionization and the associated electronic processes. At liquid nitrogen temperature these products of electron or x-ray bombardment are stable; however, the color centers are photosensitive and can be bleached both optically and thermally. The alcohols also show an increase in absorption near the characteristic uv bands. Removing the visible color centers increases the EPR hfs, but bleaching in the uv band markedly reduces or changes the hfs. In methanol and ethanol, free radicals are formed with good efficiency requiring about 18 and

12 ev per radical, respectively. Saturation concentrations of 2×10^{19} and 9×10^{19} spins per cc were produced in acetone and methanol, respectively. The hfs of ethanol and methanol indicate an alkyl hydrogen is missing from the radicals produced by irradiating these materials. No sign of the atomic hydrogen doublet was observed at liquid nitrogen temperature. Support for the α - β hypothesis was found in the hfs displayed by the irradiated alcohols, paraffins, ketones, and ethers. (auth)

10612

RADIATION CROSSLINKING OF RUBBER. II. ESTIMATION OF G VALUES. D. T. Turner (British Rubber Producers' Research Assn., Welwyn Garden City, Herts, Eng.). *J. Polymer Sci.* **35**, 541-3 (1959) Mar.

Purified natural rubber of determined osmotic molecular weight was rigorously degassed and exposed *in vacuo* to the electron beam from a 4-Mev linear accelerator. The number of moles of crosslinks per gram of rubber was estimated from measurements of equilibrium swelling in *n*-decane using Mullin's calibration with stress-strain relationships which also make possible an empirical correction to allow for the finite molecular weight of the rubber before crosslinking. (W.L.H.)

10613

A KINETIC STUDY OF IRRADIATION INDUCED PHASE CHANGES IN URANIUM-9 w/o MOLYBDENUM ALLOY. M. L. Bleiberg (Westinghouse Electric Corp., Pittsburgh). *Nuclear Sci. and Eng.* **5**, 78-87 (1959) Feb.

Uranium-molybdenum alloys were shown to transform from the stable to the metastable phase due to neutron bombardment. This phenomenon was explained on the basis of the smoothing out of concentration gradients due to the action of "displacement spikes" or "thermal pulses" generated within the sample. A kinetic study of this reaction in U-9 wt. % Mo alloy specimens was performed in which the phase reversal was followed by electrical resistivity measurements on the samples while they were being irradiated and held at low temperatures in-pile. The special facility which was constructed to perform this work, as well as the results of the first in-pile experiment, are described. The results of this test are felt to verify the displacement spike model of radiation damage. (auth)

10614

PHOTOPRODUCTION OF NEUTRAL PIONS FROM HYDROGEN IN THE ENERGY RANGE 700-1100 Mev. H. H. Bingham and A. B. Clegg (California Inst. of Tech., Pasadena). *Phys. Rev.* **112**, 2053-61 (1958) Dec. 15.

Gamma-rays from the decay of neutral pions photo-produced from hydrogen by the bremsstrahlung beam of the Caltech synchrotron were studied with a thallium chloride crystal total absorption spectrometer. The energy spectrum of the decay gamma-rays produced by a range of incident photon energy is obtained by the photon difference method and this spectrum enables a separation of the gamma-rays into two groups: (i) those from the decay of neutral pions produced singly from hydrogen and (ii) those from the decay of neutral pions from multiple-production reactions. The cross sections for the single-production reaction are in agreement with the recoil proton experiments at Caltech and Cornell. For the multiple-production reactions we measure the cross section for producing neutral pions within a range

of kinetic energies from 75 Mev to 360 Mev. It is shown that all available multiple-production data can be explained in terms of two compound states, one at about 750 Mev and the other at some higher energy. This is in agreement with an analysis of the single-photon-production data, which is given in an appendix. These two states are, respectively, ($T = \frac{1}{2}$, $J = \frac{1}{2}^+$) and ($T = \frac{3}{2}$, $J = \frac{1}{2}^+$). (auth)

10615

RADIATION DAMAGE EFFECTS IN FERROELECTRIC TRIGLYCINE SULFATE. A. G. Chynoweth (Bell Telephone Labs., Murray Hill, N. J.). *Phys. Rev.* **113**, 159-66 (1959) Jan. 1.

Peculiar changes in the ferroelectric hysteresis loops of single crystals of tryglycine sulfate result when the crystals are subjected to x-ray and electron bombardment. The effects such radiation has on the conventional dielectric hysteresis loop and on the pyroelectric properties of the crystal are described. (W.D.M.)

10616

STORED ENERGY RELEASE IN COPPER FOLLOWING ELECTRON IRRADIATION BELOW 20°K. C. J. Meechan and A. Sosin (Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.). *Phys. Rev.* **113**, 422-30 (1959) Jan. 15.

The stored energy release in copper was measured in the temperature range 20 to 60°K following irradiation with 1.2-Mev electrons. A differential temperature measurement was made between an irradiated specimen and an unirradiated standard. The specimens were immersed in liquid helium during irradiation; subsequent heating of the specimen was carried out in vacuum. A value of the total energy release of 2.5×10^{-2} cal/g was observed for an integrated flux of 9×10^{17} e/cm². The stored energy-resistivity ratio obtained is (5.4 ± 0.8) cal/g per micro-ohm-cm. The energy associated with a Frenkel pair is calculated to be (5.4 ± 0.8) ev for a value of 3.6 micro-ohm-cm per atomic percent Frenkel defects. (auth)

10617

ON THE PROBLEMS OF SYNCHROTRON OSCILLATION DAMPING. E. M. Moroz and M. S. Rabinovich. *Zhur. Tekh. Fiz.* **29**, 269-71 (1959) Feb. (In Russian)

The effects of various factors on particle oscillation damping were analyzed. A simple solution was found for the phase oscillation damping in synchrotrons using the emission electron quantum fluctuations. The solution holds true for practical uses in large synchrotrons with standard (not strong) focusing. (R.V.J.)

RADIOACTIVE WASTE

10618 CF-59-1-32

Oak Ridge National Lab., Tenn.

REMOVAL OF FISSION PRODUCTS FROM HIGH LEVEL RADIOACTIVE WASTE SOLUTIONS. R. E. Blanco and J. T. Roberts. Mar. 30, 1959. 29p. Contract [W-7405-Eng-26]. \$4.80(ph), \$2.70(mf) OTS.

Ion exchange, electrolysis, solvent extraction, scavenging, and precipitation have been studied as methods for removing radioactive isotopes from high level wastes. Process development has been limited to laboratory research and small scale engineering tests so that the efficiency of these methods in large scale operations is unknown. Emphasis has been placed on

removal of Sr^{90} and Cs^{137} which are the most biologically hazardous of the long-lived radioisotopes. Continuous processing of the supernate from neutralized sodium nitrate or aluminum bearing wastes by ion exchange appears particularly promising. Cesium and strontium have been removed by factors greater than 10^5 and 10^3 , respectively. Since about 99% of the strontium remains in the neutralized waste sludge, the overall removal for strontium was greater than 10^5 . These demonstrated purifications would reduce present Oak Ridge National Laboratory wastes to a factor of 100 above drinking water tolerance for strontium and a factor of 10 lower than tolerance for cesium. In these tests, the wastes were reduced to background levels of radioactivity and consequently, higher decontamination factors are expected when higher levels of waste are processed. Similar results are expected to be achieved for the other limiting long lived isotopes, $\text{Pu}^{239,240}$, Cm^{242} , and Am^{241} based on their known solubilities in alkaline solutions and ion exchange characteristics. Removal factors of greater than 10^4 for strontium and cesium are predicted in the treatment of acidic aluminum wastes by the Diban-Ion Exchange process following a scavenging-precipitation step. This process is considered less efficient than the neutralized treatment method since it presents more difficult engineering problems. Ru^{106} is not removed by ion exchange but can be removed by electrodeposition by factors greater than 200 which is sufficient to reduce the ruthenium concentration to below drinking water tolerance for neutralized high level wastes. Nitrate is eliminated by decomposition in the same cell. Research studies on a number of organophosphorus acids has shown that di-2-ethylhexylphosphoric acid (D2EHP) may be particularly effective for the selective extraction of strontium from neutralized wastes. A strontium distribution coefficient, $E_d^s(\text{Sr})$, of 200 and a separation factor of strontium from sodium of 2000 was determined between 0.1 M Na (D2EHP) in Amsco modified with 5% tributyl phosphate and 0.5 M sodium nitrate solution at pH 5. Tributyl phosphate is of only limited interest since it can be used to extract the rare earths, ruthenium, zirconium, and niobium but does not extract cesium or strontium. (auth)

10619 HW-58641

General Electric Co., Hanford Atomic Products Operation, Richland, Wash.

HEAT TRANSFER IN RADIANT-HEAT SPRAY CALCINATION. B. M. Johnson, Jr. Feb. 1, 1959. 22p. Contract [W-31-109-Eng-52]. \$4.80(ph), \$2.70(mf) OTS.

The fixation of aqueous radioactive wastes in a stable solid media by means of calcination is presented. The first portion of the paper develops the temperature history of a particle subjected to radiant heat transfer from the walls of a reactor. The second portion deals with the geometric factor and declination of radiation to the particle as the result of shadowing by the particles. The absorption of radiation by steam and the magnitude of its effect on heat transfer to the particles are discussed. The use of the results to predict equipment size is briefly treated. (W.L.H.)

10620 NYO-4809

Harvard Univ., Boston. Air Cleaning Lab.

AIR CLEANING STUDIES. Progress Report for July 1, 1955 to June 30, 1956. Richard Dennis, Leslie Silverman, Charles E. Billings, Edward Kristal, David

M. Anderson, and Philip Drinker. Mar. 16, 1959. 43p. Contract AT(30-1)-841. \$7.80(ph), \$3.30(mf) OTS.

Progress on the air and gas cleaning project conducted by Harvard University for the Division of Reactor Development of the U. S. Atomic Energy Commission is reported. The major objectives include research and development on air and gas cleaning devices and methods for their testing and evaluation. Investigations to evaluate and improve sampling techniques include a study of sampling nozzles, methods for minimizing flow-metering errors caused by pulsation, and preparation of a special graph for estimation of particle size parameters. Studies were continued on the role of electrostatic forces in the collection of particulates both by commercial and experimental units. Evaluation of commercial roughing filters in terms of variations in physical characteristics, a study of a new type wet collector, and a special project involving the evaluation of gas cleaning apparatus for an institutional type incinerator were continued. New projects were the rating of a commercial high-velocity cyclone as a pre-cleaner for feed materials handling operations and basic and pilot plant research on methods of cleaning high-temperature radioactive gas streams. Problems relating to I^{131} removal constitute a major part of the latter study. (For preceding period see NYO-4611.) (W.L.H.)

10621

TREATMENT OF LIQUID RADIOACTIVE WASTES.

Conrad P. Straub (Robert A. Taft Sanitary Engineering Center, Cincinnati). *Proc. Am. Soc. Civil Engrs.* 85, No. SA 1, 61-8(1959) Jan.

The experience of several Western European countries in the handling, treatment, and disposal of liquid radioactive wastes is reviewed. (W.L.H.)

10622

RADIOACTIVE POLLUTANTS. Progress Report of Task Force VI of the Committee on Atmospheric Pollution of the Sanitary Engineering Division. J. W. Thomas, J. G. Terrill, Jr., and R. A. Gilmore. *Proc. Am. Soc. Civil Engrs.* 85, No. SA 1, 75-85(1959) Jan.

The maximum permissible concentrations of radioactivity in air are discussed. Air survey methods and instruments are presented. A number of air cleaning devices are discussed. (W.L.H.)

REACTORS

General

10623 AECU-3775

Internuclear Co., Inc., Clayton, Mo.

AN ADVANCED ENGINEERING TEST REACTOR. C. F. Leyse, P. C. Bertelson, W. S. Chmielewski, W. S. Delicate, T. L. Francis, M. J. Kornfeld, and A. M. Larson. Mar. 15, 1958. 358p. Contract AT(11-1)-579. (INTERNUC-23). \$5.00(OTS).

A concept for an advanced engineering test reactor is described. The results of various investigations with regard to alternative design possibilities are presented. Detailed information is given regarding the nuclear and engineering calculations. (W.D.M.)

10624 AECU-4021

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

STUDIES OF REACTOR CONTAINMENT. Combined Monthly Progress and Financial Status Report No. 20.

T. A. Zaker. Jan. 19, 1959. 5p. Contract AT(11-1)-528. \$1.80(ph), \$1.80(mf) OTS.

In studies of stress wave attenuation in laminar blast shields, alternative methods of assessing compression wave attenuation through metal plates are being considered. Measurements of the shock reflection and crushing processes in samples of concrete, celotex, and sugar pine were made in a shock tube. Results are discussed. Approximate methods of shell analysis considering large displacement were developed and will be applied to tests which were recently conducted at the Naval Ordnance Laboratory. Propagation of pressure waves in water-steam mixtures was studied through observation of bubble collapse with high-speed motion picture photography. The slow pressure rise which was detected is evidenced by the slow collapse of the large bubbles after passage of the wave front. (For preceding period see AECU-3959.) (J.R.D.)

10625 BMI-1166

Battelle Memorial Inst., Columbus, Ohio.

HAZARDS SUMMARY REPORT FOR THE REFLECTOR-CONTROL CRITICAL-ASSEMBLY EXPERIMENTS.

Francis J. Jankowski, William S. Hogan, Robert F. Redmond, Joel W. Chastain, and Sherwood L. Fawcett. Feb. 12, 1957. Decl. Feb. 20, 1959. 80p. \$12.30(ph), \$4.50(mf) OTS.

Critical experiments are described, and the hazards attendant to these experiments are evaluated for a reflector-controlled boiling-heterogeneous-reactor design. The proposed reactor design is water moderated and reflected. However, to provide maximum flexibility and safety, the critical assembly is a thermal reactor moderated and reflected with plastic having appropriate voids to simulate water. A section of the plastic reflector is movable to represent changes in the water-reflector level. The data obtained using this reflector-controlled assembly is then supplied to an electronic reactor simulator which is connected to a full-scale mock-up of the proposed hydraulic control system. In this manner, the characteristics of the complete system are determined. The fuel-element assemblies are composed of strips of aluminum and Teflon-coated uranium sandwiched with plastic and encased in aluminum boxes. One-half of the core is on a movable table, while the other half is on a fixed table. Primary control and safety of the assembly is achieved by inserting or withdrawing sandwiched stainless steel-cadmium regulating and safety plates and by increasing or decreasing the distance between the two core halves. For safety, the maximum normal rate of reactivity addition has been limited to an estimated 0.04 per cent per sec for control-rod withdrawal, table closure, or reflector movement. The system is interlocked so that only one rod can be withdrawn at a time and so that the movable table and rods cannot be moved simultaneously. In addition, criticality cannot be reached by moving the tables together. The scram system can insert all the rods in about 0.4 sec. Hazards calculations are made to determine the dosage from direct irradiation, fall-out, and inhalation from a radioactive cloud resulting from an accident. The exclusion area is shown to be adequate for even the maximum hypothetical accident. (auth)

10626 CF-58-11-1

Oak Ridge National Lab., Tenn.

PRELIMINARY REPORT ON HEAT GENERATION AND STRESSES IN THE WALL OF A SPHERICAL HRE-4 PRESSURE VESSEL. R. D. Cheverton. Dec. 31, 1958.

18p. Contract [W-7405-eng-26]. \$3.30(ph), \$2.40(mf) OTS.

The heat generation and thermal stresses in spherical HRE-4 vessels 3 to 4½ ft in diameter with clad and solid stainless steel walls were investigated. Parameters included thorium slurry concentrations and moderator material (D₂O and H₂O). The primary purpose of this study was to determine the influence of thermal stresses on the selection of the core size for the HRE-4 reactor. Curves are presented which facilitate relatively rapid determination of stresses for the range of vessels considered. It is concluded that steady-state thermal stresses in the clad or solid stainless steel vessels considered will not have to be a determining factor in the selection of a core size, provided the power density does not exceed approximately 15 kw/l in the clad vessels and 8 kw/l in the solid stainless steel vessels. (auth)

10627 CF-59-2-25

Oak Ridge National Lab., Tenn.

CRITICAL CONCENTRATIONS FOR HRT-TYPE REACTORS SUBJECTED TO VARIOUS CONDITIONS. Roger Chalkley. Feb. 6, 1959. 3p. Contract [W-7405-eng-26]. \$1.80(ph), \$1.80(mf) OTS.

Critical concentration calculations were made for several D₂O-H₂O moderated HRT-type reactors with 30- and 28-in. core diameters and pressure vessel diameters of 60 and 54 in. A core temperature of 300°C was assumed for all cases while the blanket temperatures assumed the values 250, 280, and 300°C. The assumed moderator compositions were 80, 90, and 100% D₂O. (auth)

10628 CF-59-3-53

Oak Ridge National Lab., Tenn.

THE USE OF INCONEL AS A HIGH TEMPERATURE, CORROSION RESISTANT, THERMAL NEUTRON FLUX MONITOR. D. E. Guss and G. W. Leddicotte. Mar. 16, 1959. 12p. Contract [W-7405-eng-26]. \$3.30(ph), \$2.40(mf) OTS.

Inconel can be used for thermal neutron flux measurements by means of its cobalt impurity or its chromium constituent where conventional monitors are unsuitable. The use of cobalt should also be applicable to other nickel alloys. Discriminatory counting is required. (auth)

10629 CRRP-648

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

LATTICE EXPERIMENTS FOR CLUSTERS OF NINETEEN 1.31 CM DIAMETER URANIUM METAL RODS IN HEAVY WATER. A. Okazaki, D. F. Allen, and D. W. Hone. Jan. 1959. 40p. \$1.00(AECL).

The natural uranium metal fuel was in the form of cylindrical slugs 1.31 ± 0.01 cm diam. by 15 cm long fitted loosely into aluminum tubes 210 cm long. The clusters were suspended by a gimbal arrangement on beams which were placed across the top of the pile. The buckling of the lattice under investigation was obtained from measurements of the macroscopic flux distribution through the reactor. The thermal flux distribution through the central cell was measured to obtain the thermal utilization and thermal diffusion area. The slowing down area for the lattice was calculated. In addition to the fine structure measurements made with manganese wires, the distribution of neutron capture by U²³⁵ through the central cluster was observed. (W.D.M.)

10630 HW-51957-RD

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE EFFECT OF MODERATOR TEMPERATURE ON MAXIMUM ATTAINABLE EXPOSURE IN PLUTONIUM RECYCLE OPERATION. J. L. Carter. Aug. 21, 1957. 24p. Contract [W-31-109-Eng-52]. \$4.80(ph), \$2.70 (mf) OTS.

Preliminary results of the effects of moderator temperature on the maximum attainable exposure of a fuel element in a reactor operating on the plutonium recycle principle are presented. Knowledge of this exposure and its dependence on reactor parameters is of importance in a general survey of the applicability of various reactor types to plutonium recycle operation. Consideration was restricted to thermal reactors operating with fuel of linearly graded irradiation history. Basic results are presented in the form of graphs of maximum attainable exposure vs. temperature, using k_{∞} and r as parameters. (W.D.M.)

10631 HW-56912

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

START-UP OF A CARBON STEEL LOOP. E. L. Burley. July 21, 1958. 16p. Contract W-31-109-Eng-52. \$3.30(ph), \$2.40 (mf) OTS.

The construction, testing, operational shakedown experiences, and techniques of carbon steel reactor coolant loop startup are described. Normal fabrication techniques were used in loop construction; however, the carbon content was limited to 0.35%. The loop was used intermittently between 1956 and 1958 when it was operated at 270°C and 1300 psi at pH 10 as a part of the 1706-Ker Coolant Testing Semiworks. Radiation from the loop was low. Since completion, some of the piping surfaces were covered with a layer of black friable material which is thought to have caused valve failures, although it has caused no trouble in strainers. It is pointed out that the data are based on a relatively short term, generally at non-equilibrium conditions, and that any extrapolations must be made with reservations. (J.R.D.)

10632 IGR-R/R-210

United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.

A RAYLEIGH-RITZ PROCEDURE FOR DETERMINING THE FLUX AND THE CRITICAL LAPLACIAN OF ONE-GROUP DIFFUSION THEORY FOR HETEROGENEOUS REACTORS. R. T. Ackroyd, A. Campbell, and H. W. Haskey. Oct. 1957. 23p. (IGC-WHC(C)/P-75). \$0.49 (BIS).

A Rayleigh-Ritz procedure for determining the flux and critical Laplacian of one-group diffusion theory is given for heterogeneous reactors. The procedure is used to determine the flux and the critical Laplacian for a bare slab when the Laplacian varies almost linearly across the slab. A comparison is made with Spinney's result for diffusion theory. The present method is completely general and can be applied to arbitrary distributions of fissile material. (auth)

10633 IGR-R/R-221

United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.

APPLICATIONS OF THE RAYLEIGH-RITZ APPROXIMATION. PART II. UPPER BOUNDS FOR THE CRITICAL LAPLACIANS OF SOME COMPLEX SOLIDS.

R. T. Ackroyd and M. A. Perks. Dec. 1957. 29p.

\$0.63 (BIS).

The method of optimized parameters which was introduced in Part I is used to determine critical Laplacians and flux plots for a finite elliptical cylinder, a finite hexagonal prism, and a two-region core finite circular cylinder, all fully reflected. A typical fast reactor is used as a model for calculations in all three cases. The two-region circular reactor result is compared with the finite difference solution obtained using a computing machine. (auth)

10634 LAMS-2288

Los Alamos Scientific Lab., N. Mex.

PHYSICS OF INTERMEDIATE REACTORS. C. B. Mills and F. W. Brinkley. Jan. 1959. 49p. Contract W-7405-eng-36. \$1.50 (OTS).

The neutron diffusion approximation equations and multigroup averaged cross sections were correlated with a systematic transport approximation study of a wide spectrum of critical assemblies and the results tabulated. The small differences were corrected by neutron age considerations where significant with respect to experimental results. Initial results for temperature effects on reactivity of graphite reactors are indicated. (auth)

10635 NAA-SR-1851 and Suppl.

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

REFERENCE DESIGN FOR AN OMR-POWERED 38,000-DWT TANKER. Supplement: ENGINEERING DRAWINGS. R. J. Gimera and R. E. Stanbridge. Mar. 18, 1957. 148p. Contract AT-11-1-GEN-8. \$3.00 (OTS).

NAA-SR-1879 and NAA-SR-1880 present information related to this report and supplement.

A reference design is presented of an organic-moderated and -cooled reactor for the propulsion of a 38,000-dwt tanker. The results of a preliminary investigation of an alternate core design are given. This alternate core design is based on a flat radial thermal neutron flux concept. An estimate of personnel requirements for start-up and operation of this tanker are included. This study has shown that the OMR concept is a promising approach to supertanker operation because of exceptional safety characteristics, ease of operation, and economic potential. (auth)

10636 NAA-SR-Memo-1460

North American Aviation, Inc., [Downey, Calif.].

THE TORQUE TUBE TEST. D. L. Whitlock. Sept. 1, 1955. 10p. \$3.30(ph), \$2.40 (mf) OTS.

The torque tube is a critical part of the safety rod releasing mechanism. Deflection tests on the torque tube were made under simulated reactor conditions. The test was conducted in two parts; one test on the flattened section and one on the round section. Data presented shows a total deflection of 18° and 30 min for a 30 pound inch torque load, with the entire tube at 1100°F. No permanent set was noted after test. As the entire tube will not be at 1100°F during operation and since a 20° angular deflection of the torque tube is permissible, the torque tube as designed is suitable. (auth)

10637 NP-7178

Bureau D'Études Nucléaires, S. A., Brussels.

DETERMINATION OF REACTOR TRANSIENTS AND TIME VARIATION OF CORE MATERIAL CONCENTRATION AND EXCESS REACTIVITY BY A GRAPHICAL

METHOD. P. Stievenart and P. Erkes. [195?]. 42p., (10 illus.).

A graphical method was developed for the study of hammer effects in piping, fluid mechanics, and elasticity of solids. This method was later used for solving electric transient problems related to electrical transmission lines. The method is further developed in order to produce a graphical method for the solution of the differential equation systems which define reactor transients, the variation of core material concentrations (U^{235} , Pu, Xe), and excess reactivity with core life. (A.C.)

10638 RDB(W)/TN-70

Gt. Brit. Windscale Works, Sellafield, Cumb., England. THE MEASUREMENT OF THE THERMAL NEUTRON FLUX IN THE WINDSCALE PILES AND THE CALIBRATION OF THE NEUTRON FLUX PLOTTER GEAR. E. J. Higham. May 1953. 10p.

The thermal neutron flux at the center of B.P.P.1 was determined from measurements on the activities of irradiated samples of sodium carbonate and cobalt. The results indicate a thermal flux of $5.95 \times 10^{12} \pm 2.5\%$ neutrons/cm²/sec for a nominal power of 100 Mw and a ratio of central to average radial flux of 1.55. These results were utilized in providing an absolute calibration of the neutron flux plotter. (auth)

10639 RDB(W)/TN-108

Gt. Brit. Windscale Works, Sellafield, Cumb., England. THE CONTROL RODS OF THE WINDSCALE PILES AND THEIR ADEQUACY FOR FUTURE OPERATING CONDITIONS. R. R. Gallie and E. Smart. Oct. 1953. 12p. (WTSC/R-100).

The direct calibration of the control rods was extended from 138 to 30 cm from pile center. During the experiments, it was found that the pile k released by discharging flattening channels was dependent on their position in the pile. This effect is due to the fact that the normal operational flux distribution is modified when the control rods are in the pile. It was deduced from the experimental results that for the fully enriched pile, the pile k taken up by the flattening under shut-down conditions will be 0.2 to 0.3% less than under operating conditions. Estimates of the control required under shutdown conditions, allowing for this change in pile k taken up by flattening and assuming safety factor of 0.5% in k, show that further control of from 0.2 to 0.3% is required. It is recommended that this extra k be obtained by fitting longer extension pieces to the control rods so that they can run in to pile center and loading extra absorbers in the pile on shutdown. (auth)

10640 RISLEY-5007/4

United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England. A PRELIMINARY SURVEY OF THE THEORETICAL DESIGN OF A GAS COOLED PILE ENCLOSED IN A PRESSURE VESSEL. D. W. Ginns, H. H. Gott, and J. L. Dickson. Jan. 24, 1947. 22p. (PPDG-19).

Calculations were carried out on gas-cooled piles in which the whole of the reacting core and reflector are contained in a pressure vessel. A standard pile was assumed and the coolant used is carbon dioxide. Comparative curves for hydrogen, helium, and carbon dioxide are included for a single case. The results show that by extending the surface of the cartridges by fins or pins on the aluminum cans very large reductions in pumping power are achieved, a reduction by a factor

of 27 being quite practical. A further reduction by a factor of 7 can be achieved by introducing the gas at the center of the strings and allowing it to flow outwards in both directions. Since the results show that the gas outlet temperature approaches the sheath surface temperature, cooling by steam generation is suggested. Curves were produced showing the net recoverable electrical energy if such a system were adopted. These curves suggest that a net recovery of 15 to 20% of the nominal pile output may be obtained. (auth)

10641 WAPD-P-643

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

TREATMENT OF CONTROL RODS IN REACTOR CALCULATIONS. Stanley Stein. Mar. 2, 1955. 3p. \$1.80 (ph), \$1.80 (mf) OTS.

A scheme has been developed by Hurwitz for connecting the fluxes at two adjacent mesh points between which a control rod has been inserted. The proposed scheme specifically determines the coefficients of the matrix by means of a P_3 (or higher) approximation to a one-energy one-dimensional problem. (A.C.)

10642

CONCRETE—THE CONVENIENT REACTOR SHIELDING. PART 2. THERMAL ASPECTS. PART 3. CONSTRUCTION METHODS. T. Jaeger. *Atomic World* 10, 52-5, 63(1959) Feb.

Thermal effects on the physical and shielding properties of concrete and some of the methods used in the construction of reactor shields are discussed. Results from testing high-density concrete at elevated temperatures are reported. (J.H.M.)

10643

SYSTEMATIC INVESTIGATIONS ON THE HEAT TRANSFER AND FLOW RESISTANCE OF FINNED TUBES, A CONTRIBUTION TO THE APPLICATION OF SPECIAL TUBES IN GAS COOLED REACTORS. Günter Grass and Franz-Peter Coenen (Mannesmann-AG., Duisburg, Ger.). *Atomkernenergie* 4, 41-8 (1959) Feb. (In German)

In spite of the importance of fin tube banks in heat-transfer equipment for atomic power reactors, few experimental data previously have been available on convection heat transfer and pressure drop to flow of gases sweeping the fin tubes in cross-flow. New experimental observations on this subject therefore are of the utmost importance. The present investigations refer to measurements of heat transfer and pressure drop of single brass fin tubes for cross flow. The influence of fin height, fin spacing and Reynolds number on both qualities of tubes is graphically plotted. With certain restrictions the results on single brass tubes can be transferred to the technically more interesting banks of steel tubes, because all measurements on fin tubes are plotted according to the relationship of their qualities to the plain tube. Thus a statement about the economy of fin tubes and about the optimal dimensions is made possible. The volume as well as the pressure drop of fin tube heat exchangers, plotted against fin height with constant total heat input, pass a minimum at fin heights between 5 and 10 mm. (auth)

10644

HEAT ENGINEERING CALCULATIONS OF GAS COOLED REACTORS. II. Hans Dieter Baehr (Univ. of Berlin). *Atomkernenergie* 4, 49-55(1959) Feb. (In German)

In the second part of this article, the heat removal from the reactor is considered. Calculations are made on the distribution of the coolant flow, the pump efficiency and the reactor heat output, the net electrical power, and determination of L_G/Q_R , where L_G is the pump power and Q_R is the reactor heat output. Examples of the calculations are given for specific reactor data. (J.S.R.)

10645

NUCLEAR REACTOR DYNAMIC ANALYSIS. R. Parr (A.E.I.-John Thompson Nuclear Energy Co.) and D. V. Wordsworth (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Brit. Nuclear Energy Conf. 4, 12-20(1959) Jan.

To investigate aspects of safety or control of a nuclear reactor system requires a method of analysis of the dynamic behavior of the system following postulated disturbances or during particular operating conditions. The paper derives equations which indicate the dependence of reactor power dynamics on fundamental design parameters, the "reactivity," and the delayed neutrons for a static fuel thermal reactor, a static fuel fast reactor, and a circulating fuel thermal reactor. A method of analysis of component temperature variations is presented, with particular reference to a solid-fuel element, clad in a sheathing material, cooled on the outer surface by a flowing coolant. The coolant channel is formed in a solid moderator. A comparison of theory and experiment for the BEPO reactor shows a fair agreement, there being a maximum difference of 10% at maximum power during a transient resulting from a sudden increase in reactivity of 200×10^{-6} . (auth)

10646

ADVANCED REACTORS. J. V. Dunworth (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Brit. Nuclear Energy Conf. 4, 61-77(1959) Jan.

The factors involved, the paths to be selected, and the decisions to be made in the future in the design of advanced reactors are discussed. (auth)

10647

THE INFLUENCE OF A MULTIPLYING REFLECTOR ON THE CRITICAL DIMENSIONS OF THE HOMOGENEOUS SUSPENSION REACTOR AT DIFFERENT TEMPERATURES. R. Kladnik and A. Peterlin. "J. Stefan" Inst. Repts. (Ljubljana) 5, 25-8(1958) Oct.

Critical radii and the masses of U^{235} were calculated on the basis of two-group theory for a bare reactor (20% enriched UO_2 suspension in light water) at 20°C, and for the same reactor with natural UO_2 -light water reflector at 100 and 200°C. At 200°C there is still enough excess reactivity in the reflected reactor as compared with the bare reactor at 20°C, having the same mass of U^{235} or the same core diameter, so that the control from the start at room temperature till the power operation at 200°C can be achieved by changing the reflector level only. (auth)

10648

MULTI-LAYER CONSTRUCTION OF REACTOR VESSELS. W. Jamm. Mitt. Ver. Grosskesselbesitzer, No. 56, 348-53(1958) Oct. (In German)

The production of pressure vessels of large wall thickness built up of several tubes welded and machined to exact dimensions and then pushed inside in a special press is described. The advantages of this design are the ability to take up higher stresses and the use of different materials for the inside, intermediate

and outer layers resulting in greater safety in operation. Such vessels have already proved highly successful in the chemical industry. (auth)

10649

NUCLEAR DESIGN AND MANUFACTURE. Nuclear Eng. 4, 97-100(1959) Mar.

An introduction to the specialized design and manufacturing techniques that may be necessary in nuclear engineering projects and some indication of future trends are presented. Reliability, compatibility, maintenance, integrity, inspection, and operational conditions are discussed in the design field. Under manufacturing, inspection and shop practice are considered. (W.D.M.)

10650

NUCLEAR FUEL CYCLES. Nuclear Eng. 4, 113-17(1958) Mar.

The papers on long term reactivity changes, theory of once-through fuel cycles, perturbations due to fuel cycles, optimization of fuel cycles, neutron economy, and operational problems presented at the Symposium on Nuclear Fuel Cycles arranged by the Institute of Physics in collaboration with the British Nuclear Energy Conference on Jan. 22 and 23 are summarized. The cycling of fuel in graphite-moderated power reactors is discussed. (W.D.M.)

10651

NUCLEAR REACTORS. A. W. Aikin (to Metropolitan-Vickers Electrical Co., Ltd.). British Patent 799,001. Nuclear Eng. 4, 146(1959) Mar.

The reactor may be a fission or fusion reactor, e.g., a fast fission reactor, control of which is effected by varying the volume of a neutron absorbent liquid circulating through a ducting extending for an appreciable distance within the core of the reactor. The ducting is formed from two concentric flow and return pipes so that the neutron absorbent liquid (lithium) enters the core along one pipe and emerges along the other pipe. The liquid may be pumped upward through the (smaller) flow pipe and spill over into the (larger) return pipe where the liquid level may be controlled (e.g., by controlling the flow from the outlet).

10652

CONCRETE PRESSURE VESSELS. PART II. J. Bellier and M. Tourasse. Nuclear Energy Eng. 150-1(1959) Mar.

The theoretical aspects of concrete pressure vessel construction and use are discussed. (T.R.H.)

10653

A SIMPLE ANALYTICAL FORMULATION OF THE DANCOFF CORRECTION. J. A. Thie (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. 5, 75-7(1959) Feb.

The Dancoff correction to the surface term of a resonance integral has hitherto required tedious numerical evaluation of a double integral in cylindrical geometry. A recognition of the functional dependence of the correction on moderator mean free path λ allows a great simplification. If 1-C is the surface correction for two rods of radius, ρ , separated a distance d between centers, then $C = (4/\pi^2) K_{1/2}(|\Delta\rho|/\rho)(\rho/d) \arcsin(\rho/d)$ where $|\Delta\rho|/\rho$ is a function monotonically increasing with d/ρ , for which a graph is given. A simple formula is also given for C of a hollow rod's interior. (auth)

10654

SOURCES OF ERROR IN REACTIVITY DETERMINA-

TIONS BY MEANS OF ASYMPTOTIC PERIOD MEASUREMENTS. B. J. Toppel (Argonne National Lab., Lemont, Ill.). *Nuclear Sci. and Eng.* 5, 88-98(1959) Feb.

A common method used to determine reactivity is to measure the reactor period and then refer to the inhour equation which relates asymptotic period to reactivity. The implicit assumption in such a method is that the neutron population is varying exponentially with time. The conditions necessary for this assumption to be valid were obtained by a quantitative examination of the time behavior of the neutron population. The results obtained show that under common experimental conditions, several minutes may be required following a positive step change in reactivity in order to achieve accuracy by means of a period determination. In addition, in the case of the reactor with a constant extraneous source, a significant increase in this waiting time can result even if the reactor is initially only very slightly subcritical. Whereas in principle both positive and negative reactivities may be obtained from period observations, it is pointed out that in practice serious objections exist for the case of negative reactivities. (auth)

10655

OPERATING CHARACTERISTICS OF A GRAPHITE-MODERATED SUBCRITICAL ASSEMBLY. Robert E. Uhrig (Iowa State Coll., Ames). *Nuclear Sci. and Eng.* 5, 120-6(1959) Feb.

The Iowa State College subcritical assembly is a natural uranium-graphite pile constructed as a teaching tool to illustrate the principles of nuclear physics and engineering and as a facility for graduate thesis research in nuclear engineering. The determination of the basic operating characteristics of this assembly is described and discussed. The material buckling as determined from flux measurements was the parameter used in comparing the results. Tests were conducted for the 6 in., 8 1/2 in., and 12 in. lattice arrangements and for all uranium removed. Tests were made with air and water in the coolant annuli surrounding the uranium slugs. Bucklings were calculated using the elementary theory of Murray (in which all extraneous materials are treated as poisons) and the method of Volkoff and Rumsey (in which the moderating effect of the water and the shielding effects of the various materials are considered) for the three lattice arrangements, and they are compared with the experimental results. The position of the neutron sources in the source compartment and the presence of water around the sources were found to affect the measured value of material buckling. (auth)

10656

THE COMPUTATION OF EXCESS REACTIVITY FROM POWER TRACES. H. C. Corben (Ramo-Wooldridge, Los Angeles). *Nuclear Sci. and Eng.* 5, 127-31(1959) Feb.

The space-independent pile kinetic equations are solved to give the excess reactivity explicitly in terms of the rate of change of power and an integral over the past history of the power, the precursor densities being eliminated algebraically from the equations. The need for digital computations for determining the reactivity from a given power trace is thereby reduced. The solution is applicable to arbitrary variations of power with time and is examined in detail for the case of small damped oscillations, where it leads to simple algebraic expressions for the gain and phase angle. The behavior

of the reactivity as a function of time is also computed for the case of a power fluctuation occurring during a short time interval, for a power trace which increases exponentially and then stays constant, and for a rapidly decaying power burst. (auth)

10657

PERIOD-REACTIVITY RELATIONS DETERMINED DIRECTLY FROM PROMPT-BURST NEUTRON DECAY DATA. G. R. Keepin (Los Alamos Scientific Lab., N. Mex.). *Nuclear Sci. and Eng.* 5, 132-6(1959) Feb.

Reactor period-reactivity relations may be determined directly by numerical integration of "prompt-burst" neutron decay data without analysis into delayed neutron period and abundance values. Period-reactivity relations obtained by this method for six fissile species are compared with the corresponding relations calculated from the customary "inhour" equation. Application of this method to mixtures of fissile materials in various neutron energy spectra is discussed. (auth)

10658

SPACE-TIME BURNOUT OF AN ABSORBING SLAB. W. H. Arnold, Jr. (Westinghouse Electric Corp., Pittsburgh). *Nuclear Sci. and Eng.* 5, 137(1959) Feb.

Equations are developed which will give at any time and depth the neutron current and absorption number density for an absorbing slab. (A.C.)

10659

CONCERNING THE THEORY OF CONTROL SHEETS. H. S. Wilf (Nuclear Development Corp. of America, White Plains, N. Y.). *Nuclear Sci. and Eng.* 5, 137-8(1959) Feb.

A critical condition was derived for a plane symmetric reactor with plane control sheets inserted under the conditions that $\delta \gg \min(L, \sqrt{\tau})$, where δ is the spacing between the sheets and L and τ are the thermal diffusion length and age in the core material. (A.C.)

10660

A SIMPLE TREATMENT FOR EFFECTIVE RESONANCE ABSORPTION CROSS SECTIONS IN DENSE LATTICES. George I. Bell (Los Alamos Scientific Lab., N. Mex.). *Nuclear Sci. and Eng.* 5, 138-9(1959) Feb.

It is shown how the canonical treatment may be generalized to the case of closely spaced lumps to obtain a transition between the isolated lump and homogeneous cases. (A.C.)

10661

ÉVACUATION ET RÉCUPÉRATION DE LA CHALEUR DES RÉACTEURS NUCLÉAIRES. (Removal and Recovery of Heat from Nuclear Reactors.) Richard Alami and Paul Ageron. Paris, Dunod, 1958. 253p.

The third in a series of books on nuclear engineering is presented. In a discussion of the removal of heat from nuclear reactors consideration is given to the thermal problems in nuclear reactors, heat production and its distribution, fundamental laws of heat exchange, cooling of a reactor and heat removal under normal operation, and liquid nuclear fuels. The cycles for a steam turbine and a gas turbine are discussed in the section on thermodynamic transformation to mechanical energy of the heat produced in reactors. Brief descriptions are given of the thermal circuits of the PWR, the EBWR, the boiling water reactor with two cycles, the EL-3 at Saclay, the P-2 at Saclay, the G-1 at Marcoule, the Calder Hall, the Commonwealth Edison, the Sodium

Graphite Reactor, the EBR, the HRE and HRT, and the LMFR. The problem of thermal stresses in a reactor is also considered. (J.S.R.)

10552

LA PILE EL-3. (The EL-3 Reactor.) Jean Hainzelin, ed. Saclay, France, Commissariat à l'Énergie Atomique, Centre d'Études Nucléaires. 1958. 300p.

A complete and detailed description is given of the EL-3 reactor. An introductory chapter gives the broad outlines of the design criteria and the construction schedule. A description is given of the reactor with a consideration of a general view of the reactor installation, a description of the reactor structure, the experimental arrangements, physical characteristics, heavy water and helium circuits, other fluid circuits, control and operation, supply of electrical energy, fuel storage, gamma irradiations, observation, and administration. The technological aspects of the reactor are described in appendixes which review physical experimental study, heavy concrete, graphite machining, hydraulic tests of primary circuits, boron protection baffles, cooling the cells, corrosion in the reactor, metal clamps, detection of heavy water leaks, detection of cladding rupture, evacuation chimney for active air, measurement of the heavy water level in the reactor container, rapid measurement of the cell temperatures, control of the regulating rods, and observation of the radioactive rods. The list of industries participating in the construction of the EL-3 reactor is given. (J.S.R.)

10563

ESSAI DE CONTRIBUTION A L'AUTOPROPULSION NUCLEAIRE. (Contribution to the Nuclear Engine.) J. J. Barré (Fabrications d'Armement, Versailles, France). p. 1-36 in "VIIIth International Astronautical Congress, Barcelona, 1957, Proceedings." F. Hecht, ed. Vienna, Springer-Verlag, 1958. 612p.

Since nuclear reactors for propulsion of rockets must operate at very high temperatures (2,500 to 3000°K), the use of Pu^{239} is recommended as the fuel material. Heated to 3000°K, ammonia could attain an exhaust velocity of 4,200 m/s. Further increase in performance might be achieved by a process described as "superheating," direct heating of the working fluid by recoiling fission fragments escaping from the fissile material. In the superheating process, the working gas passes twice through the reactor core, removing heat by convective transfer during the first transit and by direct fission fragment recoil during the second passage. (W.L.H.)

10564

TRITON. Saclay, France, Commissariat à l'Énergie Atomique Centre d'Études Nucléaires. 1958. 22p. (In French)

In Triton, a swimming pool reactor using 20% enriched uranium as fuel, is being constructed at Fontenay-aux-Roses. A description is given of the reactor and its environs with consideration of the reactor building, the pool, the core, cooling and purification, control, and experimental facilities. (J.S.R.)

10565

BELGIAN MATERIAL AND ENGINEERING TEST REACTOR BR-2. Jacques Planquart (Centre d'Études pour les Applications de l'Énergie Nucléaire, Brussels). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 27p.

The BR-2 is a high-flux pressurized light-water-cooled and moderated 50-Mw research reactor. The thermal flux approaches 10^{15} n/cm²-sec at the design power level. The reactor was designed for flexibility in a variety of engineering and physics experiments. Average critical mass is 4 kg of U^{235} . (W.D.M.)

10566

QUELQUES ASPECTS TECHNIQUES DU REACTEUR BR 1. (Some Technical Aspects of the BR-1 Reactor.) G. Stiennon (Centre d'Études pour les Applications de l'Énergie Nucléaire, Brussels). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 15p.

The BR-1 Reactor is designed for scientific and technological research. The reactor is fueled with natural uranium, moderated with graphite, and cooled by air. The theoretical nuclear characteristics are tabulated. The shielding is discussed. A description is given of the fuel element unloading. The control of the reactor is obtained by the use of safety rods, coarse control rods, and fine control rods. The coolant circuit is briefly considered. The normal operation and the maximum performance operation are discussed. A description is given of the experimental facilities. (J.S.R.)

10567

EXTRACTION DE LA CHALEUR DU REACTEUR BR.1. (Heat Removal from the BR-1 Reactor.) P. Marien (Centre d'Études pour les Applications de l'Énergie Nucléaire, Brussels). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 58p.

A theoretical study is made of the cooling by forced gas convection of cylindrical uranium rods without fins resting at the bottom of a channel of the graphite structure. The heat removed by the intermediary of the graphite is considered. (tr-auth)

10568

EXPERIENCE AVEC LA PILE BR-1. (Experience with the BR-1 Reactor.) M. Neve de Mevergnies, R. Snoy, and G. Stiennon (Centre d'Études pour les Applications de l'Énergie Nucléaire, Brussels). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 3p.

Some experimental facilities of the BR-1 are briefly described. Square channels at the center of the reactor permit a determination of the neutron flux in the graphite, uranium, and air, as well as a measurement of the temperature distribution in the graphite and uranium. Vertical channels crossing the reactor from side to side allow high intensity radiations of short duration. Three channels used for measurements of absorption cross sections are discussed. (J.S.R.)

10569

LE CHOIX D'UN SYSTEME A URANIUM ENRICHI REFROIDI A L'EAU LEGERE, ET MODERE A L'EAU LEGERE ET AU BERYLLIUM POUR LE REACTEUR BR-2. (The Selection of a System with Enriched Uranium, Cooled with Light Water, and Moderated with Light Water and Beryllium for the BR-2 Reactor.) H. Dopchie (Centre d'Études pour les Applications de l'Énergie Nucléaire, Brussels). Presented at the European Atomic Energy Society Symposium on Re-

search Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 17p.

The BR-2 Reactor, now in an advanced design stage, will be light-water-cooled, light water- and beryllium-moderated, and fueled with fully enriched uranium. The coolant system is designed for reactor operation at 50 Mw, corresponding to a maximum thermal neutron flux of 8×10^{14} n/cm²sec, with an additional 25 Mw of cooling available for experimental work. A large number of through-holes traverse the core. The merits of this design are discussed and comparisons are made with other possible systems, especially with an all heavy-water system and a light-water cooled and moderated system with experimental facilities located in a D₂O reflector. (auth)

10670

SAFETY OF EXPERIMENTS. J[acques] Planquart (Centre d'Études pour les Applications de l'Énergie Nucléaire, Brussels). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 18p.

The limitation of the type of experiments that can be conducted in a reactor is whether or not the experiment compromises the safety of the reactor itself, the personnel, or the facilities at the site and surrounding areas. The conception and the design of experiments must follow strict discipline. Reactivity effects of each experiment must be carefully checked. By proper design, construction and control, all the problems of safety involved in the conduct of experiments can be handled as long as the operating conditions will stay in reasonable limits. (auth)

10671

FUEL ELEMENT TESTING BR-2 CONCENTRIC TUBE FUEL ELEMENTS. J[acques] Planquart (Centre d'Études pour les Applications de l'Énergie Nucléaire, Brussels). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 16p.

During the preliminary phase of the design of the Belgian Material and Engineering Test Reactor, a decision was made to use circular fuel elements in a beryllium matrix. Two types of fuel element sub-assemblies were taken into consideration: the sub-assembly made of coextruded seamless fuel tube and the sub-assembly made from plates bent into tubes and seam-welded. The fuel assembly consists of a concentric arrangement of fuel tubes held at their ends by fittings which, in turn, are positioned by a central support tube, acting as the main structural member. The number of fuel tubes can vary from four to six; the central hole can be used to install small experiments. In reaching the decision to use circular fuel elements, it was recognized that a development program would be required. The major tests to be done were determined as a single sub-assembly flow test and an irradiation test. At the present time, the flow test loop is in operation. (auth)

10672

BR-2 FUEL ELEMENT TESTING FACILITIES.

J[acques] Planquart (Centre d'Études pour les Applications de l'Énergie Nucléaire, Brussels). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 20p.

The Belgian Material and Engineering Test Reactor is a high-flux research reactor with great flexibility and capacity for a variety of experiments. Large experimental space is provided in the reactor itself, in beam ports and in the pool surrounding the reactor. The experimental holes in the reactor matrix are up to 222 mm in diameter, and the beam ports are up to 305 mm in diameter. The fast flux reaches 2.5×10^{15} n/cm²sec and the thermal flux reaches 9×10^{14} n/cm²sec in the experimental facilities. The design power level is 50 Mw heat; an additional 15 Mw of cooling capacity is provided for experiments. The reactor and a Core Mock-up Facility are enclosed in a containment building. A service building, a technology building, and several laboratories complete the reactor plant. (auth)

10673

FITTING OF LOOP IN BR-2. J. Planquart (Centre d'Études pour les Applications de l'Énergie Nucléaire, Brussels). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 23p.

The reactor core for the Belgian Material and Engineering Test Reactor is designed to provide large experimental spaces with high fluxes. The reactor core matrix is placed in a pressure vessel having a hyperbolic shape. The vessel lays on the bottom of a pool, underneath there is a watertight sub-pile room. At different elevation along the sub-pile room and the pool are located shielded rooms and experimental areas. Connections between different sections are made by means of watertight plugs or pipe chases. The experiment housing tube for a through loop presents at each end a connection box, providing easy access to the experiment and connections to the other sections of the loop. The in-pile tube is guided in the pressure vessel and hold from the top cover or supported in the sub-pile room. A reactor bridge is designed for use in loading and unloading the reactor. The reactor containment building is studied to handle, install and remove long pieces of equipment. The sub-pile room and the reactor pool can accommodate the simultaneous installation of five large through loops without interfering with the experiments. (auth)

10674

LOOPS FOR THE STUDY OF AQUEOUS HOMOGENEOUS REACTORS. Jacques Bernot (Commissariat à l'Énergie Atomique, Paris). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 15p.

The development of the idea to use loops as part of the French research program on homogeneous reactors is discussed. A brief description is given of a projected loop using uranyl sulfate solution at high temperature and pressure. The problems encountered by the introduction of such a circuit into the pile are analyzed. (W.D.M.)

10675

A HIGH-PRESSURE EXPERIMENTAL CIRCUIT FOR THE STUDY OF BURSTS IN URANIUM CANNING. M. Grenon (Commissariat à l'Énergie Atomique, Paris). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 24p.

A high-pressure experimental circuit designed to study the development of bursts in the canning of a re-

actor cooled by water under pressure is described, together with the two appliances connected to it, one outside the pile and the other inside, for studying the influence of actual pile conditions on the development of the bursts. Some of the industrial problems connected with the study of high pressures are presented. (auth)

10676

ACTIVITY IN COOLING MATERIALS AND THE DETECTION OF FISSION PRODUCT LEAKS. J. Labeyrie (C.E.N., Saclay, France). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 87p.

Various principles employed for leak detection in fuel elements are discussed, and it is concluded that the most logical at the moment appears to be the appearance in the coolant of the fission products, especially the rare gases and halogens. Studies which have been carried out to develop these methods and some typical leak detection installations used on different types of reactors are described. (W.D.M.)

10677

PRODUCTION OF FAST NEUTRONS WITH THE USE OF CONVERTERS. M. V. Raieviski (Commissariat à l'Energie Atomique, Paris). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 28p.

The depression of thermal neutrons produced by a converter placed in a pile is studied. The flux of fission neutrons and inelastically scattered neutrons in the inside of the converter is calculated as a function of the dimensions and of the enrichment of the latter. A comparison with some experimental results is made. (auth)

10678

CONCEPTION OF THE PILE EL 3. J. Robert (Commissariat à l'Energie Atomique, Paris). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 7p.

The five main points which dictated the design of EL-3 are discussed in some detail. The initial considerations were rapid completion of the project, high flux, versatile experimental facilities, high utilization coefficient, and safety. (W.D.M.)

10679

DESCRIPTION OF THE SWISS RESEARCH REACTORS. F. Alder, A. Colomb, A. Fritzsche, P. Schind, F. Staub, and W. Zunti (Reactor, Ltd., Würenlingen, Switzerland). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 44p.

The Swiss reactors, Saphir and Diorit, are described. Saphir, of the swimming pool type, was put into service recently, while Diorit, a heavy water natural uranium reactor, is still in the construction stage. Both reactors are located in the community of Würenlingen, Kanton Aargau. Saphir is the 1 Mw reactor operated by the USAEC at the first Geneva Conference. Diorit is a 12.5 Mw heavy water-moderated and -cooled reactor with a thermal flux of 2.2×10^{13} n/cm²-sec. (W.D.M.)

10680

ON THE ABSOLUTE AND RELATIVE MEASUREMENT OF A NEUTRON FLUX. K. E. Larsson (AB Atomenergi, Stockholm). Presented at the European Atomic

Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 17p.

Absolute neutron flux measurements are considered, and the applications of these methods as used to measure fluxes in and from reactors are dealt with. (W.D.M.)

10681

ON THE ABSOLUTE AND RELATIVE MEASUREMENT OF A NEUTRON FLUX. K. E. Larsson (AB Atomenergi, Stockholm). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 7p.

The methods available for the absolute measurement neutron flux are discussed including associated particle methods, recoil methods, threshold reactions, and thermalization methods. The present status in the field of absolute flux measurements is given as evidenced by comparison of absolutely calibrated radioactive neutron standards. (W.D.M.)

10682

A DESCRIPTION OF THE SWEDISH REACTOR R1. P. Blomberg, E. Johansson, N. G. Sjöstrand, and B. Thorell, comps. (AB Atomenergi, Stockholm). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 14p.

The first Swedish Reactor, R-1, is a natural uranium, heavy water-moderated and -cooled, 300-kw reactor. The cooling is achieved by circulation of the heavy water through an air-cooled heat exchanger. The reactor is situated in an excavation in the solid rock of about 30,000 m³. The fuel consists of 126 vertical cylindrical rods of uranium metal arranged in a rhombic lattice. (W.D.M.)

10683

THE SPANISH RESEARCH REACTOR. A. Alonso, M. Quinteiro, R. Rocher, and J. Rufz López-Rúa (Junta de Energia Nuclear, Madrid). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 29p.

The 3-Mw pool-type research reactor of the Spanish J.E.N. is described. Fuel elements are Al-U alloy 20% enriched 8-plate MTR-type. Average thermal and fast fluxes are 2.1×10^{13} nv and 6×10^{13} nv. Reactivity in the control system is 20%. The reactor is being constructed by General Electric Co. Atomic Power Dept. Forced convection cooling will be used with a water flow of 4000 gpm. Temperature of the water will be 92.5°F. (W.D.M.)

10684

THE PORTUGUESE ONE MEGAWATT SWIMMING POOL RESEARCH REACTOR. Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 3p.

The reactor to be built at Lisbon by AMF Atomics is of the conventional swimming pool type. Fuel elements are 12-plate Al-U alloy 20% enriched of the MTR-type. Average thermal flux is 6.7×10^{13} n/cm²-sec at 1-Mw operation. The experimental facilities are discussed. (W.D.M.)

10685

J.E.E.P., THE JOINT ESTABLISHMENT EXPERIMENTAL PILE. J. Coehoorn, comp. (Joint Establishment

for Nuclear Research, Kjeller, Norway). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 33p.

The natural uranium heavy water reactor JEEP is described after six years of operation. General descriptions of the reactor and building are given along with more detailed descriptions of the components. (W.D.M.)

10686

THE DUTCH "HOGER ONDERWIJS REACTOR" (H.O.R.) AT DELFT. Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 6p.

The H.O.R. is a light-water-moderated and -cooled 100-kw pool-type reactor using 20% enriched Al-U alloy fuel elements. The pool consists of two sections, separated by a watertight door. One section is to be used for shielding experiments, and the other is provided with 6 beam tubes. Experimental applications and facilities are listed. (W.D.M.)

10687

APPLICATIONS OF RESEARCH REACTORS FOR ISOTOPE PRODUCTION AND TRANSURANIUM RESEARCH. A. H. W. Aten, Jr. Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 5p.

The requirements for radioisotopes are reviewed, and the possibilities for production of presently unobtainable or scarce isotopes are discussed. Topics considered are Co⁶⁰, P³³, double neutron capture, and transuranic buildup. (W.D.M.)

10688

DESCRIPTION OF THE DUTCH MATERIALS TESTING AND RESEARCH REACTOR. Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 25p.

The Dutch Materials Testing and Research Reactor patterned after the Oak Ridge Research Reactor and to be erected at a coastal site near Petten will serve as the general purpose research tool of the Reactor Centrum Nederland. The reactor will be light-water-moderated and -cooled and will have a maximum thermal flux of about 2.6×10^{14} n/cm²-sec and a maximum fast flux close to 8×10^{14} n/cm²-sec at the design power level of 20 Mw. The reactor will have 10 beam tubes, a central vertical throughtube, an in-core U-tube, and a vertical U-tube next to the core for engineering purposes. (W.D.M.)

10689

DESCRIPTION OF THE ITALIAN C.N.R.N. REACTOR (ISPRA-I). S. Barabaschi, A. Bracci, G. Franco, and C. Salvetti. Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 5p.

The Ispra-I is a heterogeneous heavy-water-moderated and -cooled 5-Mw research reactor of the modified CP5-type. The fuel elements are 20% enriched standard 18-plate MTR-type. Thermal and fast flux maxima are 8×10^{13} and 11×10^{13} n/cm²-sec, respectively. Reactor data and experimental facilities are listed. (W.D.M.)

10690

DESCRIPTION OF DR-3. Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 1p.

The Danish Reactor DR-3 is a 10-Mw enriched heavy-water-moderated materials testing reactor of the "Pluto" type. Thermal flux is 10^{14} n/cm²-sec at 10 Mw. Fuel elements are of the MTR type with 11 plates at a 6-in. lattice pitch. (W.D.M.)

10691

DESCRIPTION OF DR-1. Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 5p.

The DR-1 is a 500-watt homogeneous solution-type thermal research reactor. The core consists of a solution of 20% enriched uranyl sulfate in light water contained in a 32-cm-diam. spherical austenitic steel vessel. With 20% enrichment the critical amount of U²³⁵ is 1.1 kg. The fuel solution concentration is about 320 g/l. Thermal flux is 1.5×10^{10} n/cm²-sec at 500 watts. Experimental facilities and possible experiments are discussed. (W.D.M.)

10692

DESCRIPTION OF DR-2. Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 6p.

The Danish Reactor DR-2 is a 5-Mw heterogeneous light-water-moderated and -cooled research reactor. The average thermal flux at 5 Mw is about 3×10^{13} n/cm²-sec. The Al-U alloy fuel elements are of the MTR type and are 20% enriched. The DR-2 is controlled by six control rods, five of which are B₄C slim-safety rods. The sixth is a stainless steel regulating rod. The proposed applications, experimental facilities, and reactor data are listed. (W.D.M.)

10693

ON THE USE OF REACTORS FOR EDUCATIONAL PURPOSES. H. Maier-Leibnitz. Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 7p.

The use of reactors in education is discussed along with the part played by the universities in Germany in the reactor field. The economic factors in reactor building and operation by the university are given. (W.D.M.)

10694

DESCRIPTION OF THE SWEDISH MATERIALS TEST AND RESEARCH REACTOR R2. R. Vestergaard (AB Atomenergi, Stockholm). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 16p.

The reactor R2 is a light-water-moderated pool-type reactor with the fuel assembly enclosed in a pressure tank. Its primary purpose is to serve as a research tool in connection with materials test experiments in very high fluxes for reactor fuel development. Thermal and fast fluxes are 2.4×10^{14} n/cm²-sec at the design power of 30 Mw. The reactor is a heterogeneous MTR type, cooled and moderated by means of demineralized light water. Fuel required is 6.1 to 7.2 kg U²³⁵, depending on operational conditions. (W.D.M.)

10695

IRRADIATION FACILITIES AT WINDSCALE WORKS. G. B. Greenough and J. Moore (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 21p.

Brief descriptions are given of experimental apparatus to determine the irradiation creep in uranium, the effect of irradiation on the creep of "Mgnox," and a rig for the irradiation of sections of the fast fission reactor fuel elements. A machine specifically designed for the withdrawal of experiments from the horizontal channels is described. The first inspection, radiographic, and metallurgical facilities developed at the Windscale Laboratories and the improved facilities which are being put into operation are illustrated. (W.D.M.)

10696

A COMPARISON OF RESEARCH REACTOR TYPES. F. W. Fenning (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, 1957. 4p.

The choice of a particular type of research reactor is never made strictly on a scientific merit basis. It is always a compromise between scientific requirements, economic limits, material availability, and limitations imposed by considerations of location and safety. The experimental requirements are briefly discussed, and a comparison is made between the various types of reactors in the U.K. (W.D.M.)

10697

CHARACTERISTIQUES PHYSIQUES DE LA PILE A HAUT FLUX EL3. (Physical Characteristics of the High-Flux Reactor EL-3.) V. Ralevski (Commissariat à l'Energie Atomique, Paris). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 24p.

The guiding ideas which led to the construction of the EL-3 are reviewed. The actual core of the reactor was realized by taking into account some thermal and nuclear considerations and some technological knowledge at the time of the design, conservatively extrapolated. The principal characteristics of the control arrangements are briefly given. The experiments done during the low-power operation are described. (tr-auth)

10698

L'UTILISATION EXPERIMENTALE DE EL 2 REACTEUR A MOYEN FLUX. (The Experimental Utilization of the EL-2 Reactor with Average Flux.) M. Seguin (Commissariat à l'Energie Atomique, Paris). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 11p.

As the EL-2 reactor at Saclay was constructed primarily for experimentation on cooling with pressurized gas, it is not adapted at all points to the needs of the experimenter. The following points are discussed: horizontal channels, vertical channels, irradiations without exterior connections, experimental assemblies with exterior connections, coördination and safety of irradiations, dosimetry, and management of the deactivation tanks. Some lessons on the use of this reactor are de-

rived, both on the installation and on the coördination and organization. (tr-auth)

10699

EXPERIMENTAL USES OF THE MEDIUM FLUX REACTORS AT HARWELL. H. R. Mck. Hyder (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 5p.

Some general remarks are made on the various research reactors at Harwell, and the advantages for the use of medium flux reactors for certain experiments are listed. The uses and limitations of the medium flux reactors at Harwell illustrate the practical importance of these advantages and are examined by reference to GLEEP, BEPO, and LIDO. (W.D.M.)

10700

THE USE OF RESEARCH REACTORS FOR SOLID STATE AND IRRADIATION RESEARCH. Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 8p.

A number of contributions to knowledge of the solid state have been made possible by the use of research reactors. Probably the largest contribution has come from neutron diffraction studies, but interest in the uses of atomic energy has stimulated research into the nature of irradiation damage in various materials much of the work employing reactors, but supplemented by use of cyclotrons and Van de Graaff machines. A number of less important applications have also been very useful, such as the use of activation analysis for determination of the purity of super-pure metals, and the use of tracer techniques for study of self-diffusion and for following the distribution of trace elements in materials. (auth)

10701

THE USE OF RESEARCH REACTORS FOR RADIATION CHEMICAL EXPERIMENTS. J. Wright (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 9p.

Among the most exacting requirements of a research reactor are the studies of chemical effects produced by reactor radiation. Some of the practical problems which arise in the use of thermal neutron reactors for research in radiation chemistry are discussed. Applications to applied and basic research are illustrated. (W.D.M.)

10702

EXPERIMENTS TO DETERMINE THE EXPECTED RATE OF HEAT PRODUCTION IN LOOPS IRRADIATED IN THE DIDO OR PLUTO REACTORS. D. Hicks (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 4p.

A simple theoretical model was found to give a good representation of the thermal neutron flux distribution observed in dummy loops mounted in the zero energy reactor DIMPLe. The experimental conditions were chosen to simulate actual loops loaded into the high flux reactors DIDO or PLUTO. It is therefore expected

that this simple model will enable rates of heat production in fuel element testing experiments to be estimated with sufficient accuracy for engineering design purposes. (auth)

10703

EXPERIMENTAL TECHNIQUES FOR SHIELDING RESEARCH. H. R. Mck. Hyder (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 3p.

Some of the problems in shield design are discussed along with some previously tried techniques. The experimental techniques used at the LIDO Reactor at Harwell are described, and the experiments now in progress are listed. (W.D.M.)

10704

THE U. K. RESEARCH REACTORS. Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 3p.

The experimental holes provided for in PLUTO are listed, and drawings are attached. The differences from DIDO are apparent from the drawings. Other differences concern the containment building and the plant layout. (W.D.M.)

10705

USE OF RESEARCH REACTORS FOR NUCLEAR DATA. V. S. Crocker (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Presented at the European Atomic Energy Society Symposium on Research Reactors and their Applications, Noordwijk, Netherlands, Sept. 10-14, 1957. 11p.

Some of the experiments that are in progress are envisaged on some of the high-flux reactors in Europe are reviewed. The experiments discussed were chosen to illustrate the present thoughts on the uses of research reactors for nuclear data, rather than an exhaustive survey of all the experiments in progress. Experiments in the U. K., Belgium, and France are summarized (W.D.M.)

10706

REACTOR CORE MATERIALS. Technical Progress Reviews, Vol. 2, No. 1. Columbus, Ohio., Battelle Memorial Institute, 1959. 56p. Available from U. S. Government Printing Office, Washington for \$0.55.

Reviews of current developments in reactor and core physics are presented. The issue includes information from pertinent papers presented at the Second Geneva Conference which were available. Fuel and Fertile Material. Elevated temperature tensile tests of irradiated U samples were conducted; results are tabulated and presented graphically. A summary of irradiated U^{235} tensile property tests is also presented. Results of irradiation tests of fully enriched U, U^{235} -Zr, and U^{235} -Cr alloys are discussed, and conclusions are listed. Results of irradiation and postirradiation tests of U-10% Mo alloy are presented including both U. S. and British work. Corrosion and thermal stability of U-Zr base alloys with Nb or Mo additions were investigated, and a discussion of the properties of various combinations is presented. Properties of Zr-70% U alloys are summarized, and results of corrosion tests of Zr-5% U alloy are discussed. Studies of U-81

systems were conducted, and corrosion test results are presented. Extensive studies of segregation in Al-U alloys were conducted. It was concluded that 13 to 19% U alloy is suitable for fuel alloys. Swelling in Zr-6 to 12% U alloys during irradiation is discussed, and results of investigations are presented. Technological progress reviews on Th-U alloys are discussed and contributions by U. S. workers as well as Canadian and British efforts are considered, followed by summaries regarding UO_2 fuel technology. Investigations on properties and behavior of UO_2 are summarized as well as fabrication studies of Th and U carbides. Corrosion mechanism studies were conducted on U, information given includes data on aqueous U reactions and negative information on the failure of Zr-U alloys. A full discussion is presented on radiation effects in metallic fuels containing U, as well as those effects in ceramic and cermet fuels. Moderator Materials. Irradiation effects on graphite are discussed, as well as graphite purity tests, bismuth penetration, oxidation rates, and physical properties of graphite-fueled UO_2 . Investigations of the properties of Be metal and alloys are reported along with work on structures of various Be oxides. Control Materials. Results from irradiation tests on boron systems are presented tabularly, and a discussion of protective coatings for control alloys such as Ag-In-Cd is presented. Work in dispersion control materials is also reviewed. Cladding and Structural Materials. Results of corrosion investigations on such materials as Zr alloys, stainless steel, Nb, Mo, and Fe-Ni alloys are discussed, as well as work done on Fe-Cr, Mg, and Al alloys. Results and comparisons of alloy corrosion by fused salts are summarized in addition to review of recent developments in Zr-water reactions. Tables and graphs containing information on the mechanical properties of cladding materials such as Zircaloy-2 and -3, Ni-base alloys, stainless steel, and Ta sheet are presented. Basic studies of radiation effects on nonfuel materials are reported. Special Fabrication Techniques. Recent results obtained in feasibility experiments on scrap-remelting for U recovery are reported. Cladding investigations using methods such as drawing and roll-bonding, pressure-bonding, diffusion-bonding, and coextrusion are discussed. Canadian extrusion-cladding experience is reported. An investigation of nonelectrolytic chemical plating, including such aspects as optimum plating conditions and properties of coatings and bonds, is reported. Finally, welding, brazing, and nondestructive testing developments are summarized. (J.R.D.)

10707

STEAM CYCLES FOR NUCLEAR POWER PLANT. Nuclear Engineering Monographs. W. R. Wootton. London, Temple Press Limited, 1958. 70p.

Principles involved in the selection of steam cycles for nuclear power plants are discussed. Considerations are given to reactors of the gas-cooled, graphite-moderated type and the water-cooled, water-moderated type, in both boiling and nonboiling form. Liquid-metal-cooled reactors are referred to briefly. Information is given on the operating characteristics of a simple steam turbine, the relation between reactor gas outlet temperature and the attainable over-all thermal efficiency of steam power plant, and steam tables. Examples of heat-exchanger heat-balance calculations are included, plus a table of the heat content of carbon dioxide. (J.H.M.)

10708

THE KINETICS AND STABILITY OF FAST REACTORS WITH SPECIAL CONSIDERATIONS OF NONLINEARITIES. Armin Henry Sandmeier. Thesis, Swiss Federal Institute of Technology, Zurich. 1959. 88p.

The linear kinetics of fast reactors is discussed in the first two chapters, chapter I dealing with zero power kinetics and chapter II with linear power kinetics. The third chapter treats the influence of nonlinearities on the dynamics. (T.R.H.)

Power

10709 AECU-4026

Duquesne Light Co., Shippingport, Penna.
DETERMINATION OF THE CHEMICAL CHARACTERISTICS OF THE 1C BOILER. SECTION III. Test Results DL-S-209. First Issue, Feb. 9, 1959. 34p. \$6.30(ph), \$3.00(mf) OTS.

Data were collected to determine the chemical operating characteristics of the 1C Boiler. The test procedure is described and results are presented tabularly and graphically. The results indicated the existence of a chemical hideout during full load operation and further indicated that a stabilized steam pocket existed in the upper region of the heat exchanger adjacent to the inlet tube sheet during high steaming rates. It is concluded that the observed conditions were similar to those which contributed to tube failures in the 1B Boiler. Tests performed after the installation of new risers indicated the steam pocket was no longer present. (J.R.D.)

10710 AECU-4029

Duquesne Light Co., Shippingport, Penna.
ROD DROP TRANSIENT. SECTION I. Test Results DL-S-247 (T-641323). First Issue, Feb. 16, 1959. 21p. \$7.80(ph), \$3.30(mf) OTS.

An investigation was made to obtain data on plant performance after a single rod has been dropped with the plant at 13 Mw gross generator output. Results indicate that the operation of the plant after a single control rod had been dropped was within allowable limits. (auth)

10711 AECU-4030

Duquesne Light Co., Shippingport, Penna.
DETERMINATION OF COEFFICIENTS OF REACTIVITY. SECTION I—560 EFPH. FOURTH PERFORMANCE. Test Results DL-S-151 (T-550132). First Issue, Jan. 31, 1959. 59p. \$9.30(ph), \$3.60(mf) OTS.

The temperature and pressure coefficients of reactivity at zero power were determined. The value for the temperature coefficient at the operating temperature of 523°F with 556.6 EFPH plant operation was $2.5 (\Delta K/F) \times 10^{-4}$. The magnitude of the temperature coefficient at the plant operating temperature (523°F) indicates the reactor is very stable during normal operations. The pressure coefficient varied from values of $1.41 (\Delta K/\text{psig}) \times 10^{-4}$ at 1437 psig to $1.57 \times 10^{-4} \Delta K/\text{psig}$ at 1882 psig at a constant temperature of 450°F. The accuracy of the value of this pressure coefficient is questionable as it differs greatly from values previously obtained which were in close agreement. (auth)

10712 AECU-4031

Duquesne Light Co., Shippingport, Penna.
CONTROL ROD POSITIONS FOR CRITICALITY. SECTION I. THIRD PERFORMANCE. Test Results

DL-S-149 (T-550130). First Issue, Feb. 12, 1959. 13p. \$1.80(ph), \$1.80(mf) OTS.

Critical rod bank heights and bank worths were determined from information obtained on the scalers used to determine startup rates of various configurations. The critical bank heights and worths are tabulated, and reactivity vs. bank height is presented graphically. (J.R.D.)

10713 AECU-4046

Duquesne Light Co., Shippingport, Penna.
ROD DROP TRANSIENT TEST. SECTION II. Test Results DL-S-247 (T-641323). First Issue, Feb. 12, 1959. 21p. \$4.80(ph), \$2.70(mf) OTS.

The operation of the plant after a single control rod (No. 23) had been dropped was within the allowable limits. The information obtained from the high speed recorders could not be evaluated accurately due to the fast chart speed and also because they were calibrated to cover a much wider range than was necessary. The necessary data were obtained from the normal plant recorders in most instances. The high speed recorders for future performances should be operated at a slower speed (1 mm/sec) throughout the entire test and should be calibrated to give the highest degree of accuracy in the range of the expected results. (auth)

10714 AECU-4058

Atomic Power Development Associates, Inc., Detroit.
HEAT TRANSFER FROM SPENT FUEL AND BLANKET SUBASSEMBLIES DURING TRANSFER FROM REACTOR TO DECAY STORAGE FACILITY. Technical Memorandum No. 2. L. L. Kintner. May 15, 1957. 60p. Contract [AT(11-1)-476]. \$9.30(ph), \$3.60(mf) OTS.

During the transfer of spent fuel and blanket subassemblies from the reactor to the decay storage facility, the subassemblies must be moved through an inert gas. The heat generation due to the decay of fission products is sufficiently large that provisions must be made for cooling the subassembly when in the gas. The transfer equipment was designed for conduction, radiation, and natural convection cooling only. Various steps in the transfer process are explained, and computations on heat generation and transfer are given. (W.D.M.)

10715 AECU-4060

Atomic Power Development Associates, Inc., Detroit.
FISSION GASES IN MOLTEN FUEL, FAST REACTORS. Technical Memorandum No. 4. Evan C. Kovacic. July 3, 1957. 6p. Contract [AT(11-1)-476]. \$1.80(ph), \$1.80(mf) OTS.

Some of the problems that fission gases cause in a fast, molten-fuel reactor operating at a high power density are presented. (W.L.H.)

10716 AECU-4061

Atomic Power Development Associates, Inc., Detroit.
SOME NUCLEAR CONSIDERATIONS IN FUEL RELOADING AND CONTROL. Technical Memorandum No. 8. E. L. Alexanderson. Aug. 12, 1957. 15p. Contract [AT(11-1)-476]. \$3.30(ph), \$2.40(mf) OTS.

The APDA reactor will be operated initially with 92 cents of control reactivity. This will allow 20 cents for temperature over-ride, 30 cents for control margin, and 42 cents for fuel burn-out and element growth. There are 6 different reasons for requiring a control margin, and 30 cents may not be adequate. Thus, even less than 42 cents may be available for shimmiing, and careful scheduling of subassembly re-

placements is necessary. Several possible power and load factor conditions are assumed and charts presented to show cycling of core and part of the blanket fuel. Individual fuel subassembly removal times are chosen so as to obtain very close to maximum allowable burn-up and to minimize cycle to cycle variations in reactivity. (auth)

10717 AECU-4063

Atomic Power Development Associates, Inc., Detroit. SURVEY OF THE RADIATION LEVELS IN THE CONTAINMENT VESSEL OF THE ENRICO FERMI ATOMIC POWER PLANT. PART I. GAMMA RADIATION LEVELS IN THE EQUIPMENT COMPARTMENT DUE TO PRIMARY SODIUM ACTIVITY AND ASSOCIATED FISSION PRODUCT CONTAMINATION. Technical Memorandum No. 16. W. F. Chaltrou and H. E. Hungerford. Sept. 4, 1958. 51p. Contract [AT(11-1)-476]. \$9.30 (ph), \$3.60(mf) OTS.

The results are presented of a gamma radiation survey of the equipment compartment. The following six radioactive sources within the sodium were used: Na^{24} , Na^{22} , and four cases of fission product contamination. The four cases of fission product contamination are divided as follows: Case I—fission products from uranium occurring naturally in the sodium, Case II—fission products leaking into the sodium at 6×10^{-7} of the rate of their production, Case III—fission products from dissolution of one complete pin in the primary coolant, and Case IV—fission products from the dissolution of 14 complete pins. Two conditions of the system were considered under various operating and shutdown procedures: (1) normal, and (2) drained. The calculations were made by first dividing the primary system into various discrete sources, and then computing the contributions of each source to each point on a coordinate system representing the equipment compartment. The various conditions of the system which were considered and results of the calculations are presented. Entry into the equipment compartment under the various assumed conditions is discussed. (auth)

10718 AECU-4064

Atomic Power Development Associates, Inc., Detroit. DESIGN BASIS FOR THE FUEL HANDLING AND DECAY STORAGE FACILITY. Technical Memorandum No. 18. W. W. Kendall, R. A. MacLeod, and D. D. Peden. Nov. 14, 1958. 37p. Contract [AT(11-1)-476]. \$6.30(ph), \$3.00(mf) OTS.

The design basis is given for the fuel handling and decay storage facility. The units to be handled include the core and blanket subassemblies, the control rods, the neutron source, and the surveillance specimens. The handling operations include receiving of new units, inspection before irradiation, inspection after irradiation, radioactive decay in a pool of water, disposal of waste material, and the shipment of radioactive material from the plant site. (auth)

10719 APAE-43(Vol. I)

Alco Products, Inc., Schenectady, N. Y. APPR-1 RESEARCH AND DEVELOPMENT PROGRAM DECONTAMINATION PROGRAM. TASK II. VOLUME I. CONTAMINATION AND DECONTAMINATION IN NUCLEAR POWER REACTORS. John L. Zegger and Guyon P. Pancer. Feb. 13, 1959. 73p. Contract AT(30-3)-326. \$9.30(ph), \$3.60(mf) OTS.

A survey of the problem of reactor system contamination by radioactive material and methods that have been

employed to remove the material was carried out. Following this survey, an investigation of chemical solutions was undertaken to find one which might be successfully employed in the decontamination of a stainless steel steam generator. From a preliminary screening, the most promising chemical method from the view point of minimum corrosion and maximum decontamination is a caustic permanganate treatment followed by an acid rinse. (auth)

10720 APAE-43(Vol. III)

Alco Products, Inc., Schenectady, N. Y. APPR-1 RESEARCH AND DEVELOPMENT PROGRAM DECONTAMINATION PROGRAM. TASK II. VOLUME III. RECOMMENDED PROCEDURE FOR DECONTAMINATION OF A STAINLESS STEEL STEAM GENERATOR. Guyon P. Pancer and John L. Zegger. Feb. 13, 1959. 25p. Contract AT(30-3)-326. \$4.80 (ph), \$2.70(mf) OTS.

A decontamination procedure for a stainless steel steam generator similar to the APPR-1 using a fill-flush application of a caustic permanganate-citrate combination solution is recommended. The isolation of the steam generator is to be accomplished by means of specially designed plugs at the reactor vessel outlet and at the primary coolant pumps. Anticipated results, including corrosion rates and decontamination factors, are presented. (auth)

10721 APDA-128

Atomic Power Development Associates, Inc., Detroit. THERMAL BOWING OF CORE SUBASSEMBLIES. Feb. 20, 1959. 41p. \$6.30(ph), \$3.00(mf) OTS.

The potential bowing problem in a core of the Fermi type is associated with the core subassembly bowing which could result in relatively large core geometry changes if no steps are taken to prevent it. This problem in the design of the Enrico Fermi Reactor is dealt with, and the method which has been adopted to avoid a positive temperature coefficient of reactivity is discussed. (W.D.M.)

10722 NAA-SR-Memo-988

North American Aviation, Inc., Downey, Calif. SRE FUEL ROD DROP TESTS. W. J. Hallett and C. H. Robbins. May 12, 1954. Decl. Nov. 6, 1958. 19p. \$3.30(ph), \$2.40(mf) OTS.

A series of tests was performed to study the effects of accidentally dropping a fuel element because of a failure of the SRE fuel handling equipment. It is concluded that an accident resulting in a drop of as much as 12 feet will not cause rupture of the fuel jackets. A drop of the maximum possible, 24 feet, probably will result in rupture of the jacket, but only a few slugs should fall out as the jacket tubing tends to retain the slugs because of a decrease in diameter. (auth)

10723 NAA-SR-Memo-1584

North American Aviation, Inc., Downey, Calif. CALIBRATION OF SRE TYPE ORIFICE PLATES. C. R. Davidson. Mar. 7, 1956. 26p. \$4.80(ph), \$2.70 (mf) OTS.

The orifice plates for the SRE were calibrated in the hydraulic model tank loop at the Santa Susana Facility. Orifice plates having hole diameters of 0.250, 0.375, and 0.625 in. were studied in pressure drop ranges from 0.1 to 3 psig with the orifice plate assembly mounted coaxially in the pipe. Discharge coefficients ranging from 0.79 to 1.00 were obtained for Reynolds Numbers from 2×10^4 to 3×10^5 . (auth)

10724 NDA-84-17

Nuclear Development Corp. of America, White Plains, N. Y.

REACTIVITY STUDIES ON NATURAL URANIUM-D₂O LATTICES (CALCULATION METHODS SURVEY AND EXPERIMENTAL RESULTS). W. L. Brooks, H. Soodak, and J. Agresta. Mar. 31, 1959. 46p. Contract AT (30-3)-256. \$7.80(ph), \$3.30(mf) OTS.

In an attempt to improve the knowledge of the reactivity characteristics of SDR lattices two separate programs were followed. An investigation of means of improving reactivity calculation methods so that reliable reactivity calculations can be made without recourse to experiments and an experimental program designed to provide reactivity data on lattices of interest to the SDR program are summarized. Under the calculation methods survey, thermal utilization, cross sections for the fast fission factor, and resonance escape probability are investigated. (W.D.M.)

10725 NP-7305

New York Univ., New York. Coll. of Engineering. EVALUATION OF POTENTIAL RADIATION HAZARD RESULTING FROM ASSUMED RELEASE OF RADIOACTIVE WASTES TO ATMOSPHERE FROM PROPOSED BUCHANAN NUCLEAR POWER PLANT. Technical Report No. 372.3. Ben Davidson and James Halitsky. Apr. 1957. 66p. For Consolidated Edison Co. of New York, Inc.

Meteorological features of the area surrounding the site of the Indian Point Power Reactor were surveyed. Findings are summarized. Estimates are presented of the radiation hazard associated with routine and non-routine operation of the plant. Results and radiation calculations are summarized. Estimates are made of the maximum hourly and weekly beta and gamma dosage and the distribution of the annual dosage. These dosages are computed on the basis of routine plant operation with the radioactive wastes assumed to be released in the center of the heated jet rising from the superheated stack. Technical data upon which the estimates are based are summarized. Results are summarized from diffusion experiments made at the site. Methods for evaluating diffusion coefficients are described, general features of the climatology of the site are discussed, and climatological data are summarized. Results are presented from heated plume calculations, methods of integrating the radiative flux equation are given, and the technique is described by which these equations were combined with the climatological, diffusion, and heated plume data to produce the results obtained. (C.H.)

10726 ORNL-2676

Oak Ridge National Lab., Tenn. GAS-COOLED REACTOR PROJECT SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1958. Mar. 16, 1959. 176p. Contract W-7405-Eng-26. \$3.00(OTS).

The program is divided into two principal parts: design investigations and materials research and testing. Most of the activities described were initiated in support of the prototype gas-cooled power reactor (GCPR) designed by Kaiser Engineers-ACF Industries. Some advanced reactor design studies were made, and basic design studies required to facilitate design review work were completed that have application beyond the limited review objective. In furtherance of an assigned responsibility for providing the fuel elements for the GCPR, methods for fabricating and testing fuel elements were

developed. Tests of mechanical properties were undertaken as required to obtain the information needed in the development of the fuel elements. In-pile and out-of-pile tests of the components and materials of the reactor core were also initiated. (For preceding period see ORNL-2500.) (auth)

10727 WAPD-MRP-78

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. PRESSURIZED WATER REACTOR (PWR) PROJECT TECHNICAL PROGRESS REPORT FOR THE PERIOD DECEMBER 24, 1958 TO FEBRUARY 23, 1959. 93p. Contract AT-11-1-GEN-14. \$2.25(OTS).

Work on thermocouples for PWR-1 is described. An analysis was completed of allowable reactor power in PWR-1 for the interval after 3000 EFPH using synthesized three-dimensional flux distributions resulting from the current control rod program. For PWR-2, the photoelastic investigation of the four-subassembly blanket cluster design was completed. Steady-state core thermal performance calculations were made for a rod programming different from the anticipated reference programming of four control rods fully inserted at equilibrium xenon conditions through 8000 EFPH and zero rods inserted 8000 to 10,000 EFPH. The analysis of core behavior during loss-of-flow accidents was completed for the reference design. Corrosion tests on nickel-free Zircaloy are described. The experiment on irradiation induced reversion in γ -phase U-Nb base alloys was concluded. In-pile hot water loop exposure of Ni, Cu, Fe enriched Zircaloy-2 indicates that only Ni accelerates pickup of H. In-pile exposure of Zircaloy clad 1.8 wt. % B¹⁰ alloys with iron, austenitic and ferritic stainless steel to full B¹⁰ burnup indicated severe damage. Work on Cd-In-Ag alloy alternate control rods was completed. High density, single-phase solid solutions of ZrO₂-UO₂ which are stable in high temperature, high pH water were fabricated. Results of a long-time anneal of a cylindrical Zr thermal gradient diffusion specimen showed complete sweeping out of all hydride phase from the hotter portion into the cooler portion. Measurements of Rn²²⁰ emanation in sintered UO₂ platelets indicated an activation energy of Rn²²⁰ diffusion of about 60 kcal/mole for the temperature range 1100 to 1500°C. Work was completed on the three-dimensional synthesis study of PWR-1. The validity of a synthesis technique for predicting control rod critical positions in PWR-1 was evaluated. Evaluation of the PWR-1 reactivity depletion rate between 1690 and 2790 EFPH indicated a loss rate of $1.0 \pm 0.3\% \Delta \rho$ per 1000 hrs. Various methods of representing lumped poisons in two-dimensional analyses were investigated. Measurements were completed in the PWR-2 mock-up assembly of the change in the one-rod-stuck shutdown margin caused by zone loading in the seed subassemblies. (For preceding period see WAPD-MRP-77.) (W.D.M.)

10728 WCAP-571

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh and Pennsylvania Power and Light Co., Pittsburgh.

A STUDY OF THE TEMPERATURE AND PRESSURE IN THE REACTOR AND THE DRAIN TANKS OF THE PAR DURING AN EMERGENCY DRAIN. D. F. Rinald. June 15, 1957. 14p. \$3.30(ph), \$2.40(mf) OTS.

The temperature, pressure, and distribution of materials in the drain tanks were computed during simulated emergency drain, based on a number of reasonable

assumptions. It was concluded that to avoid initial thermal shock to the drain tanks, the first 10% of the solids should be drained at a much lower rate than was used in this calculation. In this way a greater portion of the decay heat will be released in the primary system. The partial pressure of D_2O in the primary system will be increased, providing additional force to drain the last slurry from the reactor. The D_2 in the primary system gas phase will be diluted and will reach safe proportions more quickly. (J.R.D.)

10729 YAE-121

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

MONTHLY PROGRESS REPORT FOR THE PERIOD FEBRUARY 1 TO 28, 1959. H. E. Walchli. Mar. 20, 1959. 14p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. \$3.30(ph), \$2.40(mf) OTS.

The work performed or coordinated by the Westinghouse Atomic Power Department for the Yankee Atomic Electric Company during the month of Feb. 1959 is summarized. (For preceding period see YAE-119.) (W.D.M.)

10730 IGR-T/R-89

STEAM-COOLED POWER REACTOR. A. Schraud. Translated by D. H. Hill (U.K.A.E.A., Risley) from *Atomkernenergie* 3, 133-6(1958). 9p.

The special possibility of using a steam cooled reactor in a nuclear power station is described. Water steam as a coolant is superheated by passing through a heterogeneous reactor. At the outlet such an amount is bled off to the turbine plant, that the remaining steam can be cooled back to the entrance temperature by mixing it with the turbine condensate. Results of a preliminary design study for a 20 Mw plant are given. The reactor is moderated by light water and uses enriched uranium oxide in stainless steel tubes as fuel. The net power costs of the plant are estimated to be 1.16d/kwh. (auth)

10731

THE CHOICE OF THE STEAM CYCLE IN COMBINED COMBUSTION-NUCLEAR FISSION POWER PLANTS. H. Benzler (Deutschen Babcock & Wilcox Dampfkesselwerke AG., Oberhausen, Ger.). *Atomkernenergie* 4, 56-61(1959) Feb. (In German)

The steam cycle in a combined combustion-nuclear power plant is discussed. Consideration is given the idealized single pressure steam cycle, idealized multi-pressure cycle, actual steam cycle, and effect of pressure level number on steam cycle with and without superheating. (auth)

10732

ARCHITECTURAL CONSIDERATIONS OF ATOMIC POWER STATIONS WITH SPECIAL REFERENCE TO SHIELDING. László Irsy. *Energia és Atomtech.* 11, 303-9(1958) Apr.-May. (In Hungarian)

Problems involving the architectural design of reactors and hot laboratories are discussed. Shielding materials for neutrons and gamma radiation, including the preparation of special baryte-containing concretes, are described. The need for cooperation between engineers, physicists, and the architect is emphasized. (R.V.J.)

10733

CONCRETE PRESSURE VESSELS. NOVEL DESIGN AND CONSTRUCTION IN FRENCH REACTORS G2 AND

G3. J. Bellier and M. Tourasse. *Nuclear Energy Eng.* 13, 85-9(1959) Feb.

The prestressed concrete pressure vessels for Marcoule Reactors G2 and G3 are described. The vessels are horizontal cylinders 46 ft in internal diameter, 59 ft long, and 10 ft thick. Steel plates line each vessel to make it gas tight. The vessels can withstand pressures of 213.31 psig under normal conditions and 426.7 psig for test purposes. (W.D.M.)

10734

THE ADVANCED GAS COOLED REACTOR. *Nuclear Energy Eng.* 13, 96-7(1959) Feb.

The advanced gas-cooled reactor (AGR) being built at Windscale is described. The AGR is to be a stage between the present commercial reactors and the planned high-temperature gas-cooled reactor. Steam conditions, refueling, and control are discussed. Contracts already placed are listed. (W.D.M.)

10735

HALDEN BHRW. *Nuclear Eng.* 4, 106-12(1959) Mar.

The boiling heavy water reactor at Halden which is scheduled to go critical shortly is described, and a cutaway drawing is presented. The reactor, a Dutch-Norwegian project, is regarded to be experimental although a load exists for the steam when the experimental work is completed. The containment is a cavern excavated from a mountain. (W.D.M.)

10736

NUCLEAR REACTOR. P. Fortescue and J. P. Middleton (to U. K. Atomic Energy Authority). British Patent 799,212. *Nuclear Eng.* 4, 146(1959) Mar.

A stream of gas circulates in the primary circuit through the reactor core and is used to drive a gas turbine; it then passes through a heat exchanger, and a compressor to be compressed back to a sufficient pressure to circulate the coolant. The secondary circuit from the heat exchanger provides heat for power production by any suitable means.

10737

NUCLEAR POWER PLANT. P. Fortescue (to U. K. Atomic Energy Authority). British Patent 799,575. *Nuclear Eng.* 4, 146(1959) Mar.

A plant for experimental or breeding purposes is built up of a reaction vessel containing a critical mass of fissile material (enriched uranium hexafluoride and beryllium fluoride as moderator in a nickel vessel), a temperature and pressure reducing device (turbine), a heat exchanger, and a condenser. The fissile gas is expanded in the reaction vessel, reduced in temperature and pressure in the turbine, used as heating medium in the exchanger, and returned to the condenser.

10738

NUCLEAR REACTORS. M. L. A. Moncrieff (to General Electric Co., Ltd.). British Patent 800,388. *Nuclear Eng.* 4, 146(1959) Mar.

The reactor core is arranged within a pressure vessel of concrete consisting of a central annular section and two end closure sections. The joints between the sections are constructed as dry joints during the fabrication of the vessel. The sections are coupled by mild steel bars having anchoring plates in the adjacent sections between longitudinal prestressing bars. By this means relative lateral movement is possible between adjacent sections while the coupled parts remain resistant to internal pressure.

10739

WAYS OF POWER SUPPLY DEVELOPMENT IN THE USSR. G. A. Matveev (Khrzhizhanovsky Electrotechnical Inst., Moscow). *Priroda* 48, No. 1, 73-82(1959) Jan. (In Russian)

A review is given of the power production in the USSR and of the future goals. The absolute figures of total power production for 1958 was 233 billion kw. In 1960 it should reach 320 billions and in 1965 up to 500 to 520 billion kwh. In addition to conventional power plants, plans are made for constructing several nuclear power plants of 400 to 600 Mw for districts removed from conventional fuel sources. Several experimental power plants and reactors are planned for colleges and research centers. According to plans, nuclear power plants of 2 to 2.5 million kw should be in operation in 1956 to 1960. The first section of a nuclear power plant (100 Mw with total capacity of 600 Mw) was in operation last year. (R.V.J.)

10740

POWER REACTOR TECHNOLOGY. Technical Progress Reviews, Vol. 2, No. 2. Dunedin, Fla., General Nuclear Engineering Corp., 1959. 55p. Available from U. S. Government Printing Office, Washington for \$0.55.

Nuclear Ship Propulsion. General economic considerations involving fuel costs, plant costs, ship speed, and cargo capacity are discussed. The characteristics of marine reactors currently in design study or construction stages are tabulated, and the status of the U.S.S. Savannah project is reviewed. The main conclusions reached by the American-Standard study of nuclear ship economics are summarized and discussed. Reactor Physics. Neutron slowing down in homogeneous moderators, graphite, graphite-bismuth mixtures, iron, and stainless steel is reviewed. Experimental and theoretical work on the physics of light-water-moderated and cooled power reactors is also reviewed. A discussion is given of the Doppler coefficient for U^{238} and of the effect of holes on slowing down and diffusion areas. Results of experimental work at Harwell using DIMPLE and GLEEP pile oscillator facilities are summarized. Estimated reactivity lifetime in D_2O reactors is treated. Thermal Considerations. A review is presented on heat transfer and thermal cycles for gas-cooled systems, and on properties of gases. Reactor Control: Burnable Poisons. A discussion and review are presented. Shielding. Neutron removal cross section data and concretes for reactor shielding are reviewed. Fuel Elements. Recently developed electron-beam and vacuum-welding techniques are reviewed along with electro-cladding and lead bonding of fuel elements. Reactor Materials. Reviews containing recent data on properties of graphite, Zr, and Zr alloys are presented. Fuel Cycles. Two topics are reviewed: U^{238} problem in isotope separation plants, and isotope buildup in recycled fuel. Heavy-Water Reactors: Leakage Detection. A review of methods of analysis for heavy water and tritium monitoring is presented. Boiling Reactors: Turbine Corrosion and Erosion. A review is presented. (T.R.H.)

STABLE ISOTOPE SEPARATION

10741 IGRL-T/CA-91

THE ISOTOPIC ANALYSIS OF SOLIDS BY MEANS OF THE "MS" MASS SPECTROMETER. L. E. Levina.

Translated by E. G. Peters (U.K.A.E.A., Risley) from *Priroda i Tekh. Ekspt.*, No. 5, 114-16(1957). 5p.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 10789.

10742

THE CONCENTRATING OF THE N^{15} ISOTOPE WITH THE AID OF A CHEMICAL EXCHANGE REACTION. Adolf Zeman and Vladimir Cermak. *Chem. listy* 51, 818-22(1957). (Translated from *Referat. Zhur. Khim.* No. 11, 1958, Abstract No. 35307.)

A single-stage enrichment column for concentrating N^{15} with the aid of an exchange reaction between NH_4^+ and NH_3 (gas) is described. The column was 8.3 meters long, 12 millimeters wide, and provided with a cap consisting of 2×4 millimeter vitreous texture rolls. After a lapse of 27 days, the concentration N^{15} rose from 0.365 at. % to 11.4 at. %. The total enrichment factor is $Z = 35.1$; the height, equivalent to the theoretical stage, is 5.3 centimeters.

10743

RESULTS OF LOW TEMPERATURE RESEARCH. XXII. THE ENRICHMENT OF N^{15} BY RECTIFICATION OF NITRIC OXIDE. Klaus Clusius and Kuno Schleich (Univ. of Zurich). *Helv. Chim. Acta* 42, 232-9(1959). (In German)

Heavy nitrogen is of importance for homogeneous breeder reactors in case it could be produced cheaply enough in commercial quantities. The rectification of nitric oxide may be the most profitable process from the energy standpoint of the methods proposed. It is reversible and shows a large elementary separation effect, which is only exceeded by the chemical $NO-HNO_3$ method. But there is the disadvantage that it must be coupled with the production of sulfuric acid from pure sulfur dioxide. In the NO rectification undesired by-products are missing, whereas the possibility of obtaining simultaneously the heavy oxygen isotopes O^{17} and O^{18} is welcome. The rectification method with glass columns of special construction is described, and the expected results were obtained. In a 10 mm wide column a height equivalent theoretical plate (HETP) of 10 cm was obtained. Because of the large separation factor a column length of 31 cm is sufficient at an operating pressure of 200 mm Hg for the displacement of both isotopes by the factor e . (tr-auth)

TECHNOLOGY

Feed Materials

10744 MCW-1420

Mallinckrodt Chemical Works, St. Louis.

A PROCESS FOR CONTROLLING INSOLUBLE URANIUM IN ORE CONCENTRATES I. LABORATORY INVESTIGATION. G. P. Lang, E. N. Nelson, and C. W. Kuhlman, Feb. 2, 1959. 33p. Contract W-14-108-eng-8. \$1.00(OTS).

A process has been developed for converting nitric-acid-insoluble uranium in ore concentrates into soluble form. Ore concentrates are treated with a reducing agent such as carbon monoxide or hydrogen at temperatures of 670 to 730°C. In the laboratory, retention times required to reach a given level of insoluble uranium vary inversely with the concentration of the reducing

agent. Laboratory studies leading to the development of the process are reported. (auth)

10745 MCW-1423

Mallinckrodt Chemical Works, St. Louis.

A PROCESS FOR CONTROLLING INSOLUBLE URANIUM IN ORE CONCENTRATES. II. ANALYTICAL INVESTIGATION. W. M. Wise and W. C. Stoecker.

Feb. 2, 1959. 18p. Contract W-14-108-eng-8. \$0.75 (OTS).

Laboratory work leading to the development of two methods for determining insoluble uranium in feeds is presented. The first consists of acid dissolution of the feed, fusion of the insoluble material with potassium pyrosulfate, and spectrophotometric determination of uranium. The second, developed as a referee method, is based on acid dissolution of the feed and titrimetric determination of uranium in the insoluble portion. (auth)

10746 NLCO-774

National Lead Co. of Ohio, Cincinnati.

LABORATORY AND PILOT PLANT EVALUATION OF COLORADO VITRO AND CANONBURG VITRO URANIUM CONCENTRATE. Nelson R. Leist, Clark T. Hicks, and Joseph R. Nelli. Oct. 24, 1958. 23p. Contract AT(30-1)-1156. \$1.00(OTS).

The laboratory and pilot plant evaluations of Canonsburg Vitro and Colorado Vitro concentrates are presented. These concentrates meet all FMPC impurity tolerance limits. Laboratory digestion tests have revealed that both concentrates contain excessive quantities of nitric acid-insoluble uranium at normal digestion conditions. The insoluble uranium content of these concentrates can be reduced by a "hot-concentrated" digestion procedure. A pilot plant pulse column test indicated that these materials can be processed in normal National Lead Company of Ohio refinery feed blends when this "hot-concentrated" digestion procedure is utilized. (auth)

10747 NLCO-776

National Lead Co. of Ohio, Cincinnati.

LABORATORY AND PILOT PLANT EVALUATION OF MILLIKEN URANIUM CONCENTRATE. Nelson R. Leist, Clark T. Hicks, and Joseph R. Nelli. Nov. 20, 1958. 19p. Contract AT(30-1)-1156. \$0.75(OTS).

The laboratory and pilot plant evaluation of Milliken uranium concentrate is presented. This concentrate meets all FMPC impurity tolerance limits. Laboratory digestion and extraction tests indicate that this material should present no problems in pulse column processing. A pilot plant pulse column test indicated that this material should present no operational problems in the National Lead Company of Ohio Refinery. (auth)

10748 NLCO-777

National Lead Co. of Ohio, Cincinnati.

LABORATORY AND PILOT PLANT EVALUATION OF STANLEIGH URANIUM CONCENTRATE. Nelson R. Leist, Clark T. Hicks, and Joseph R. Nelli. Jan. 6, 1959. 19p. Contract AT(30-1)-1156. \$0.75(OTS).

The laboratory and pilot plant evaluation of Stanleigh concentrate is presented. This concentrate meets all FMPC impurity tolerance limits except those for thorium and chloride. The thorium limit can be met by the addition of phosphate as required for thorium-containing uranium concentrates or by blending with low thorium concentrates. The high chloride content of this material will necessitate the blending of the material with a good quality low-chloride-content concentrate in the National

Lead Company of Ohio refinery process. Laboratory digestion and extraction tests indicate that this material should present no other problems in pulse column processing. A pilot plant pulse column test indicated that this material should present no operational problems in the FMPC Refinery. (auth)

10749

THE REFINING OF URANIUM IN THE UNITED KINGDOM. D. P. Hamilton (United Kingdom Atomic Energy Authority, Springfields, Lancs, Eng.). *Nature* 183, 786-7(1959) Mar. 21.

The Springfields Works in the United Kingdom supplies uranium fuel elements for the country's power and experimental reactors. The processes involved in the production of the fuel elements, which includes refining and fabrication, are described. (J.H.M.)

10750

PRODUCTION OF URANIUM. (To U. K. Atomic Energy Authority.) British Patent 798,518. *Nuclear Eng.* 4, 146(1959) Mar.

It has been found that uranium tetrafluoride is particularly suitable for producing massive uranium metal and it may be obtained by reacting the tetrafluoride, which should have a particle size such that 75% pass a 60 mesh screen, with magnesium of a particle size not greater than 7 mesh.

Raw Materials

10751 AECU-4041

Bureau of Mines. Intermountain Experiment Station, Salt Lake City.

PROCESSING OF THE COMMISSION BLEND OF COLORADO FRONT RANGE URANIUM ORES (AEC-455.24). I. L. Nichols, J. R. Ross, K. E. Tame, and J. B. Rosenbaum. Feb. 1959. 53p. (RR-53.2). \$9.30 (ph), \$3.60(mf) OTS.

Acid and alkaline processing of Commission Blend Colorado Front Range uranium ores is described. The composition of the blend is listed according to source and chemical composition. The processes investigated in laboratory and pilot plant work included concurrent and countercurrent acid leaching, alkaline leaching, and recycle of alkaline leach solution. In addition pre-roasting followed by acid and alkaline leaching, flotation of carbon and sulfides followed by acid leaching the concentrate, and alkaline leaching of the flotation tailings were investigated. It was concluded that the acid process employing countercurrent leaching and washing, amine solvent extraction and the reuse of the raffinate and the alkaline process employing a pressure leach using oxygen followed by conventional caustic precipitation are the best methods and are about equal economically. Flotation appears attractive for a large plant operation. (J.R.D.)

10752 AECU-4047

Bureau of Mines. Intermountain Experiment Station, Salt Lake City.

PROCESSING OF THE COTTER BLEND OF COLORADO FRONT RANGE URANIUM ORES (AEC-455.25). I. L. Nichols, K. E. Tame, and J. B. Rosenbaum. Feb. 1959. 19p. (RR-53.3). \$3.30(ph), \$2.40(mf) OTS.

The results of laboratory and pilot plant alkaline leaching of the Cotter Blend are described. The Cotter Blend composition is given in relation to source and

chemical composition. It was demonstrated that specification-grade yellow cake with high recovery of uranium could be produced from Cotter Blend by an alkaline process. A pressure leach under oxygen pressure followed by caustic precipitation recovered 93.1% of the U. (J.R.D.)

10753 WIN-109

National Lead Co., Inc. Raw Materials Development Lab., Winchester, Mass.

ACID LEACH—CCD—SOLVENT EXTRACTION PILOT PLANT TESTING OF HOLLY MINERALS COMPANY ORE. Merle A. Peters and Ralph L. Shimmin. June 20, 1958. 68p. Contract AT(49-6)-924. \$10.80(ph), \$3.90(mf) OTS.

Holly Blend ore from the Holly Minerals Company of the Ambrosia Lake district in New Mexico was treated in the Acid Leach—Countercurrent Decantation—Solvent Extraction Pilot Plant at Grand Junction, Colorado. Detailed information is presented on leaching, countercurrent decantation, clarification, and solvent extraction as applied in the processing of this ore. Results show

the ore to be amenable to the Acid Leach—Countercurrent Decantation—Solvent Extraction process. (auth)

10754 AEC-tr-3593

TREATMENT OF URANIUM ORE. I. LEACHING OF URANIUM ORE AND PRECIPITATION OF URANIUM SALTS. (Zpracovani Uranovych Rud. I. Louzeni Uranovych Rud a Srazeni Uranovych Soli.) Jiri Beranek and Frantisek Holub. Translated from *Jaderná Energie* 4, No. 2, 34-9(1958). 13p. \$3.30(ph), \$2.40(mf) JCL or LC.

Methods of leaching iron ores and precipitation of U from solutions are discussed. In addition, a brief review of development and present state of U ore processing technology in Czechoslovakia is given. It is pointed out that economical U ore processing depends primarily on the choice of a correct leaching method. Laboratory tests are used to determine the best leaching method. Relationships between leaching and ore grain size are presented graphically. Flowsheets and schematic outlines of purification procedures are included. (J.R.D.)

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Vienna, Institut für Radiumforschung der Oesterreichischen Akademie der Wissenschaften

Vienna, International Atomic Energy Agency

BELGIUM

Brussels, Centre d'Etudes pour les Applications de l'Energie Nucléaire

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DENMARK

Risø, Danish Atomic Energy Commission

DOMINICAN REPUBLIC

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London, Science Museum Library, South Kensington

Manchester, Central Library

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Nottingham, Public Libraries

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Frankfurt/Main, Omelin-Institut

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Athens, Greek Atomic Energy Commission

GUATEMALA

Guatemala, Comisión Nacional de Energía Nuclear

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IRELAND

Dublin, University College

ISRAEL

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